US009486327B2

(12) **United States Patent**
**Martynova et al.**

(10) **Patent No.: US 9,486,327 B2**
(45) **Date of Patent: Nov. 8, 2016**

(54) **STANDALONE INTERBODY IMPLANTS**


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(73) Assignee: **GLOBUS MEDICAL, INC.**, Audubon, PA (US)


( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.


(21) Appl. No.: **14/556,345**

(22) Filed: **Dec. 1, 2014**

(65) **Prior Publication Data**

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**Related U.S. Application Data**

(63) Continuation-in-part of application No. 14/278,898, filed on May 15, 2014.

(51) **Int. Cl.**

| | |
|---|---|
| ***A61F 2/44*** | (2006.01) |
| *A61F 2/30* | (2006.01) |
| *A61F 2/28* | (2006.01) |

(52) **U.S. Cl.**

CPC ............... ***A61F 2/447*** (2013.01); ***A61F 2/442*** (2013.01); *A61F 2002/2835* (2013.01); *A61F 2002/3008* (2013.01); *A61F 2002/30014* (2013.01); *A61F 2002/3038* (2013.01); *A61F 2002/3039* (2013.01); *A61F 2002/30202* (2013.01); *A61F 2002/30204* (2013.01); *A61F 2002/30387* (2013.01); *A61F 2002/30434* (2013.01); *A61F 2002/30472* (2013.01); *A61F 2002/30482* (2013.01); *A61F 2002/30487* (2013.01);

(Continued)

(58) **Field of Classification Search**

CPC ...... A61F 2/44; A61F 2/4405; A61F 2/4455; A61F 2/442; A61F 2/447; A61F 2002/4475

See application file for complete search history.



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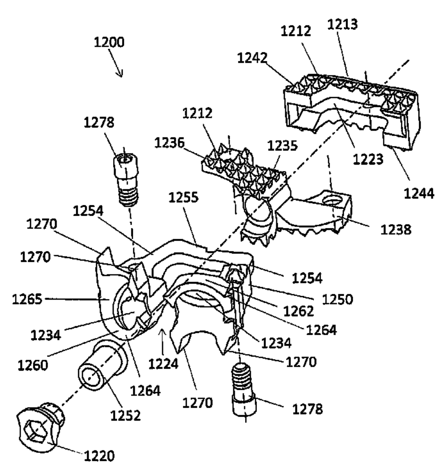
*Primary Examiner* — Anu Ramana

(57) **ABSTRACT**


Stand-alone interbody fusion devices for engagement between adjacent vertebrae. The stand-alone interbody fusion devices may include frames and one or more end-plates coupled to the frame. The frame may be configured and designed to provide the apertures which are designed to retain bone fasteners, such as screws or anchors, and secure the implant to the adjacent vertebrae.


**16 Claims, 33 Drawing Sheets**



(52) **U.S. Cl.**
CPC ................. *A61F2002/30504* (2013.01); *A61F 2002/30571* (2013.01); *A61F 2002/30578* (2013.01); *A61F 2002/30607* (2013.01); *A61F 2002/30616* (2013.01); *A61F 2002/30787* (2013.01); *A61F 2002/30822* (2013.01); *A61F 2002/30823* (2013.01); *A61F 2002/30828* (2013.01); *A61F 2002/30843* (2013.01); *A61F 2310/00011* (2013.01); *A61F 2310/00023* (2013.01); *A61F 2310/00131* (2013.01); *A61F 2310/00359* (2013.01)

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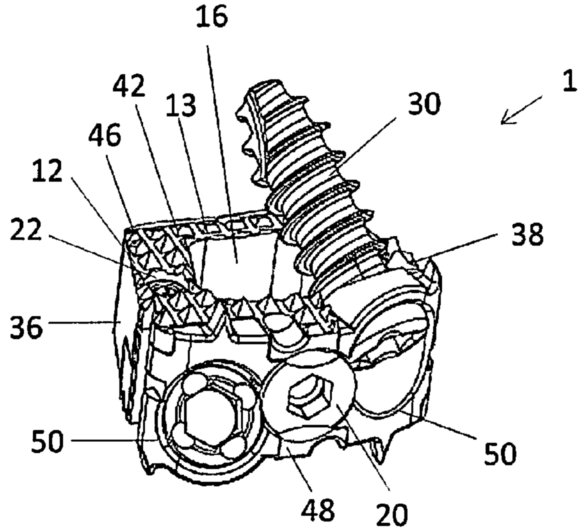
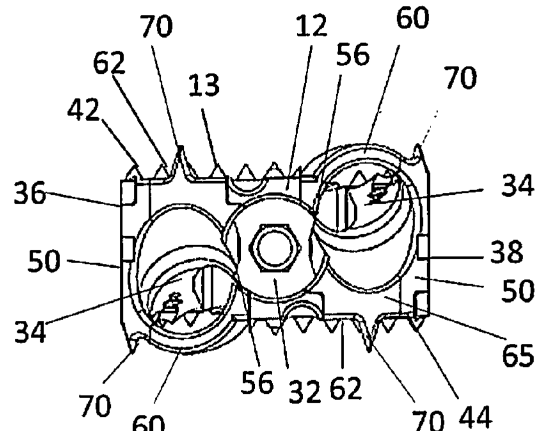



FIG. 1A

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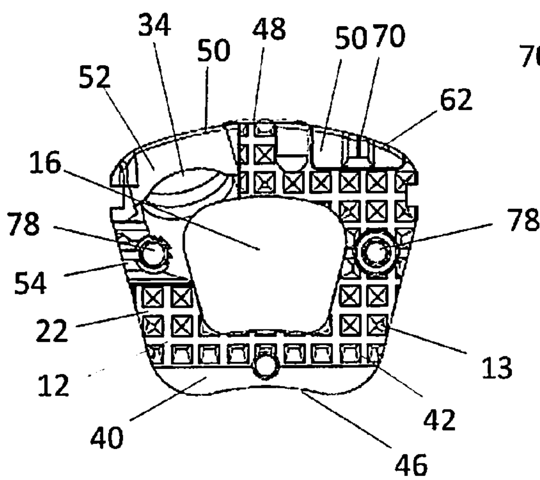


FIG. 1C

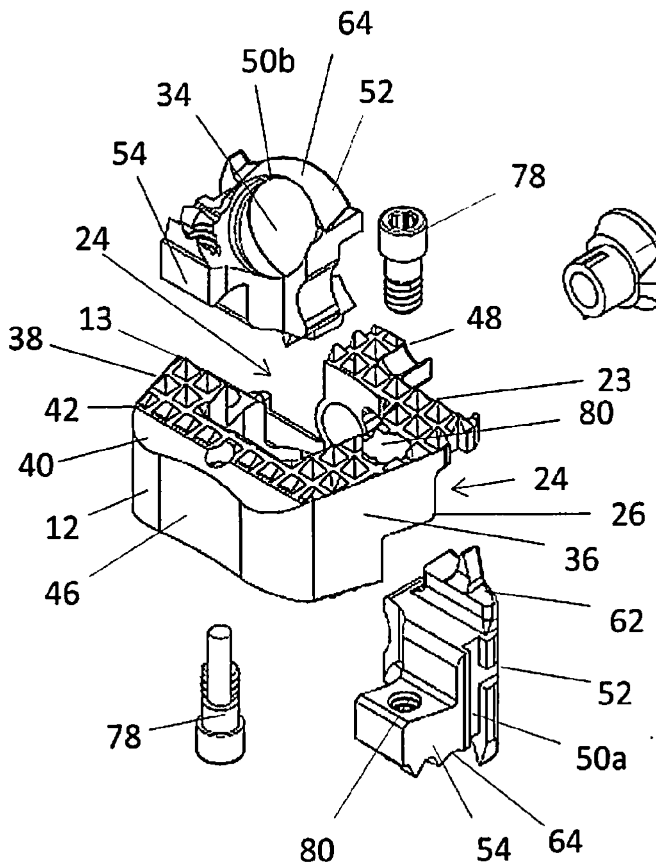
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FIG. 1D

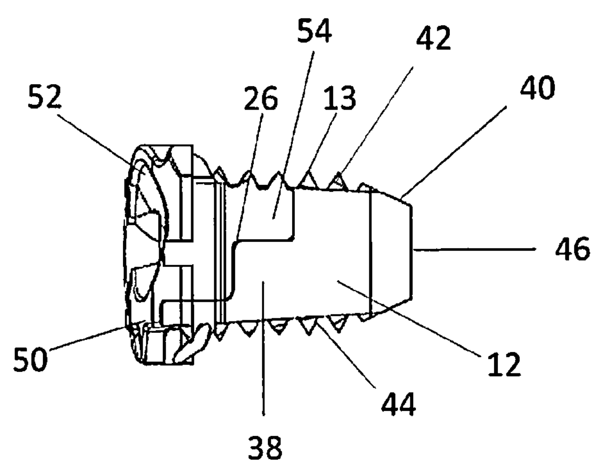
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FIG. 1E

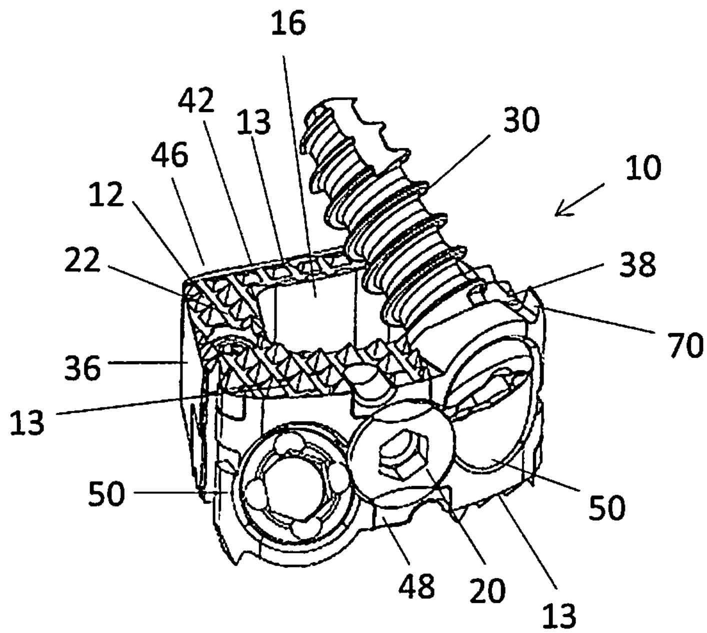
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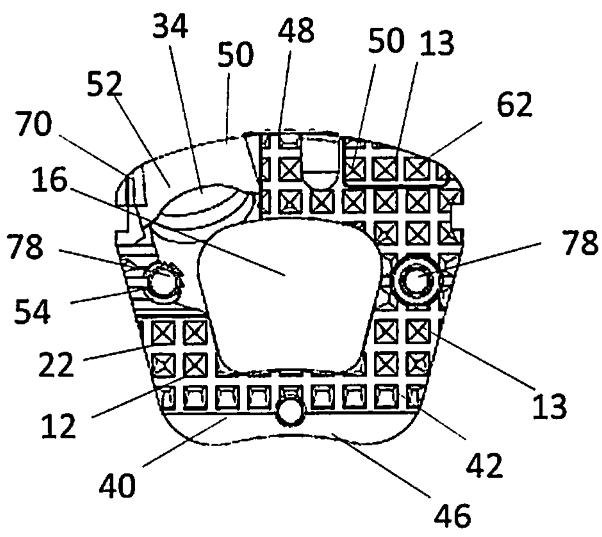
FIG. 2A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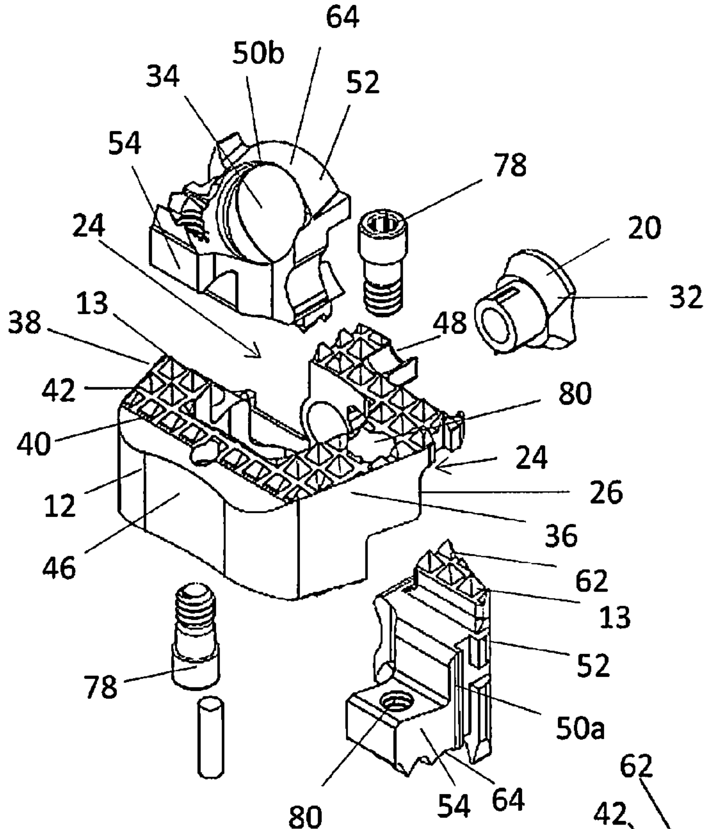


FIG. 2C

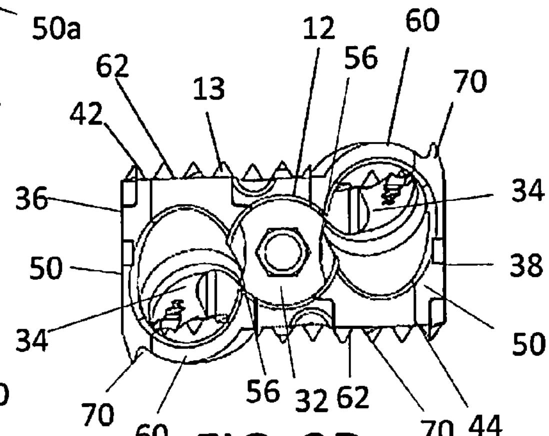


FIG. 2D

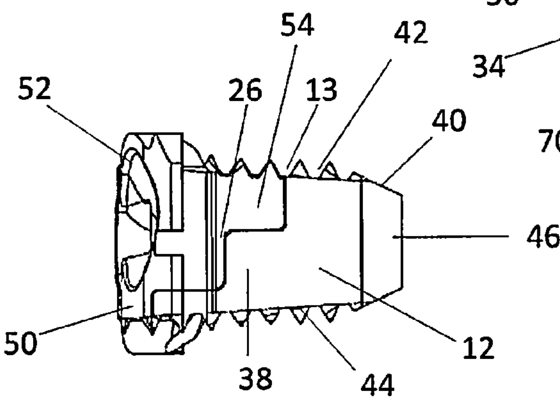


FIG. 2E

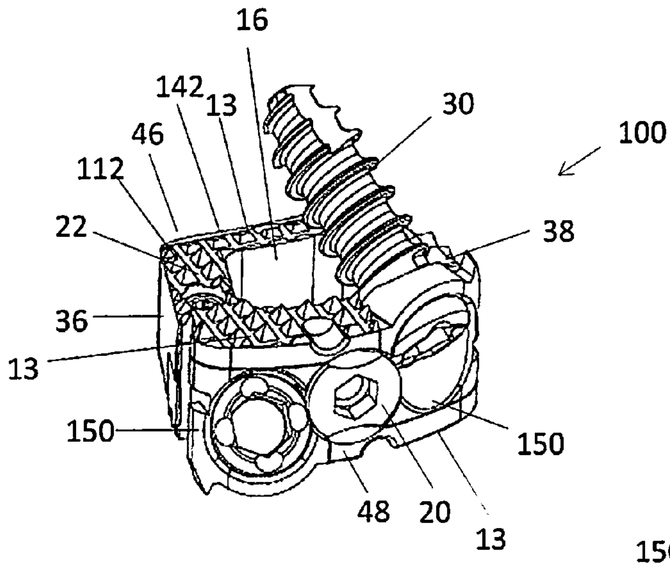
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FIG. 3A

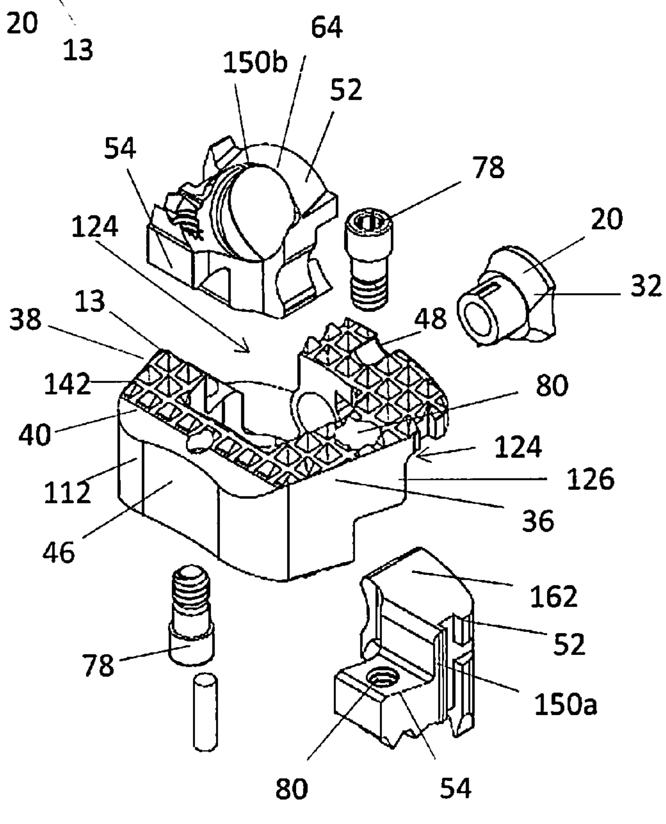
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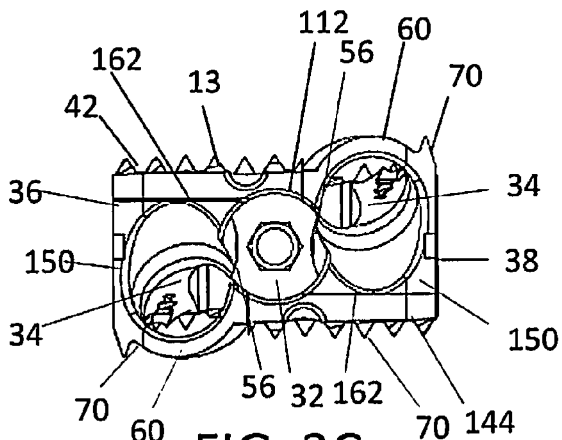
FIG. 3B

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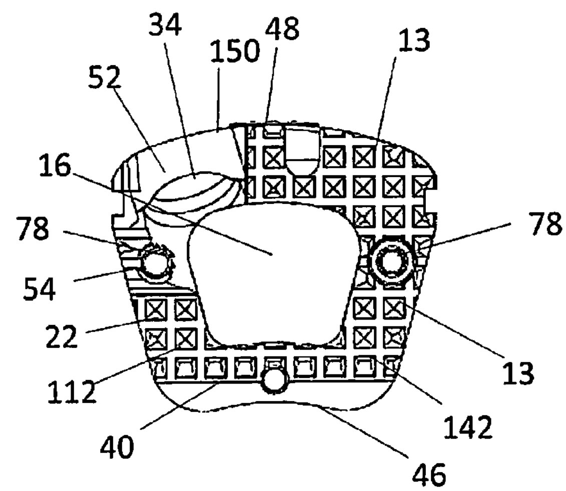


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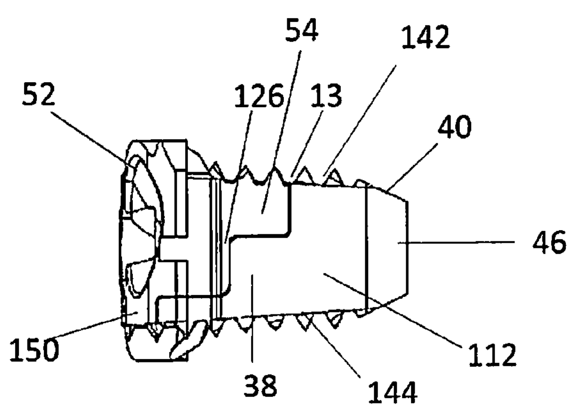
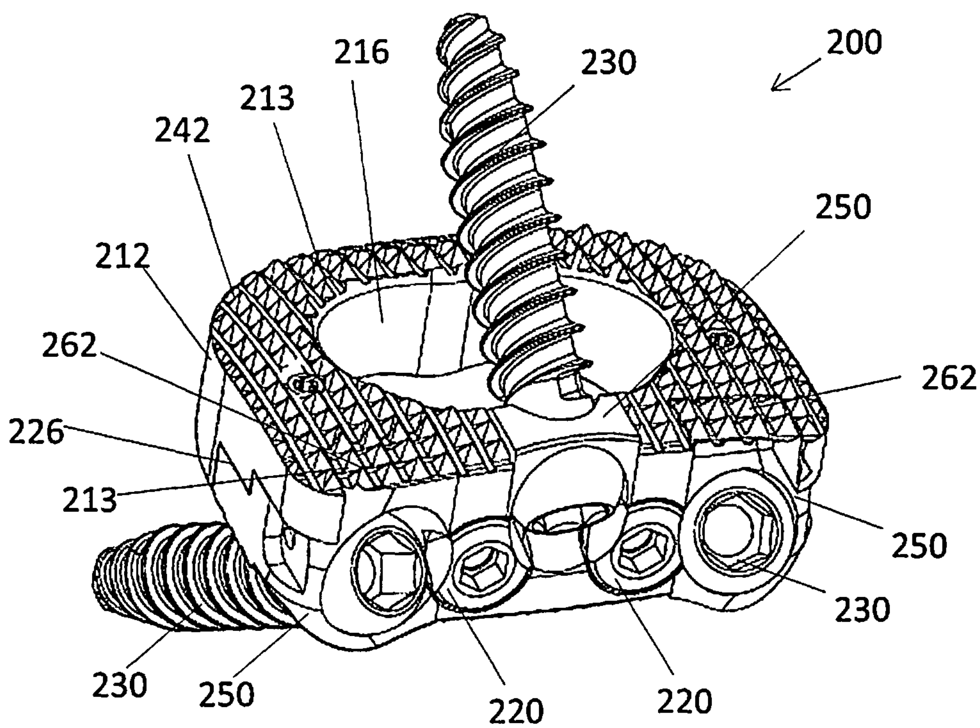



FIG. 3E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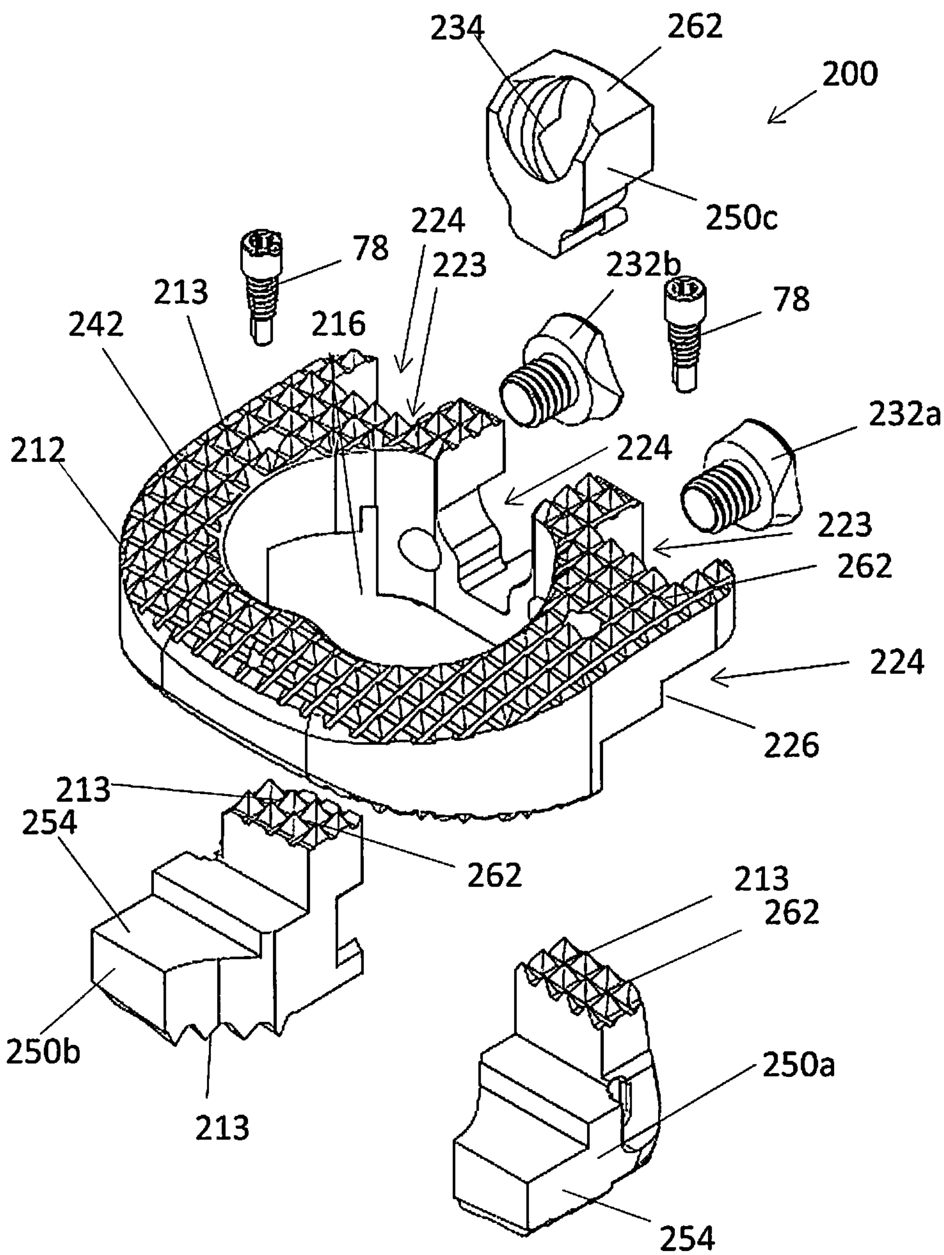
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FIG. 4B

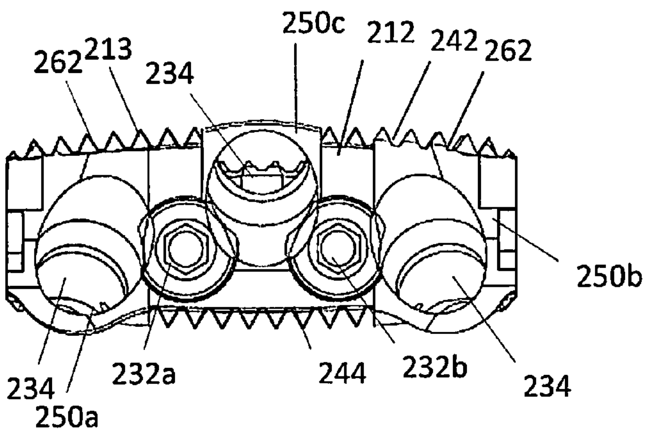


FIG. 4C

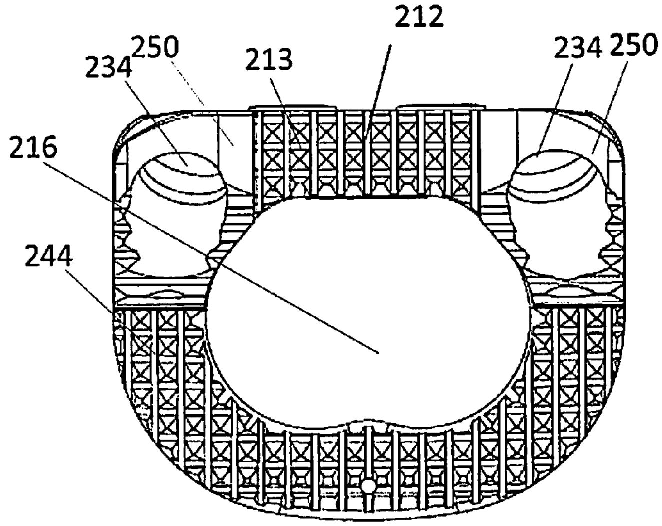


FIG. 4D

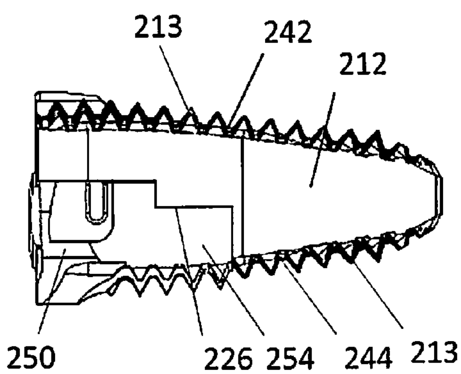


FIG. 4E

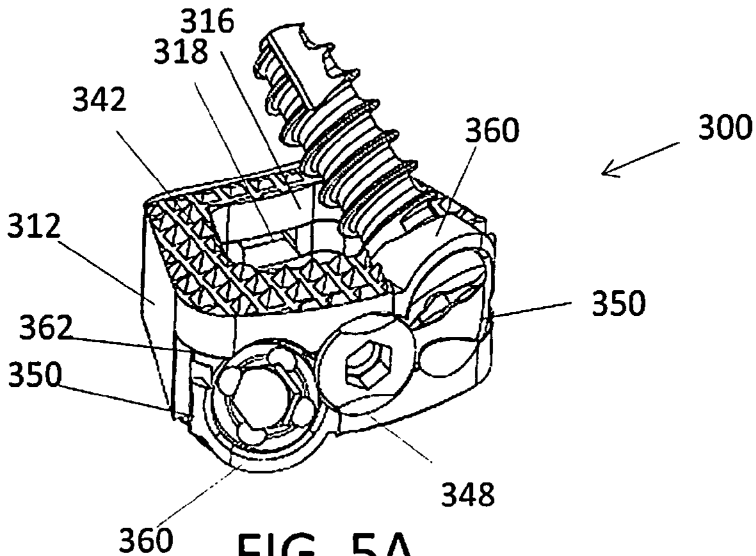
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FIG. 5A

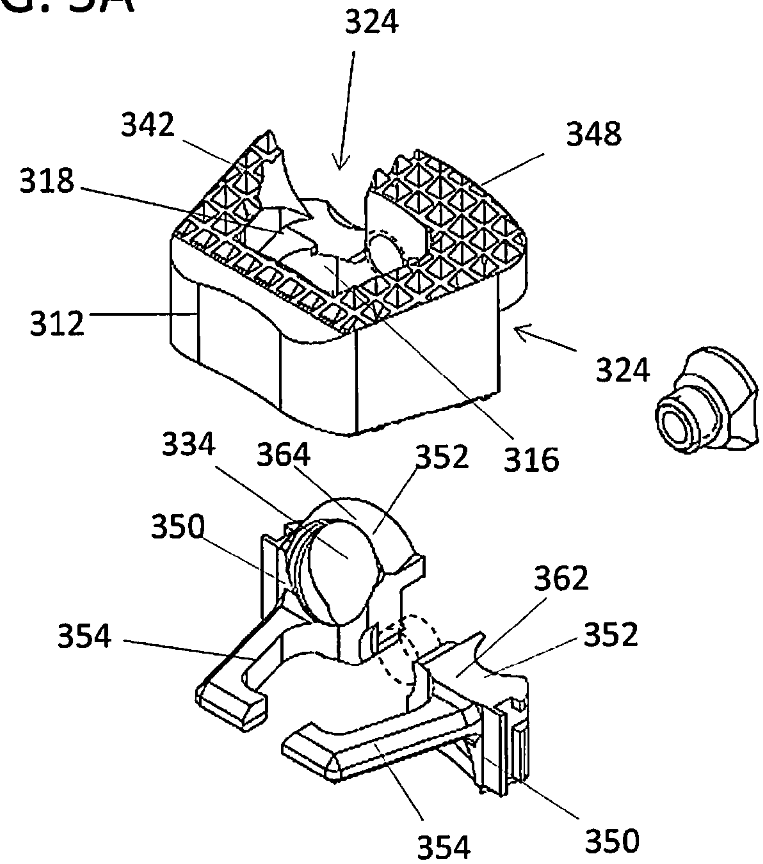
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FIG. 5B

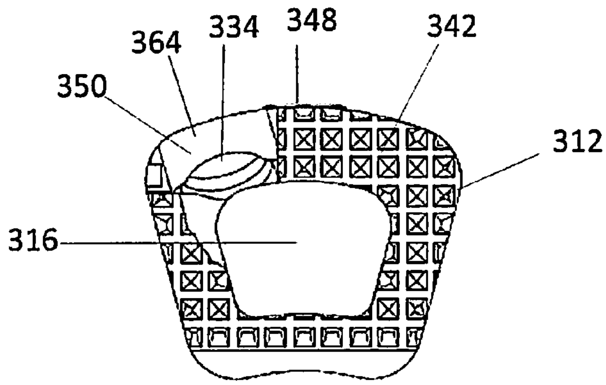


FIG. 5C

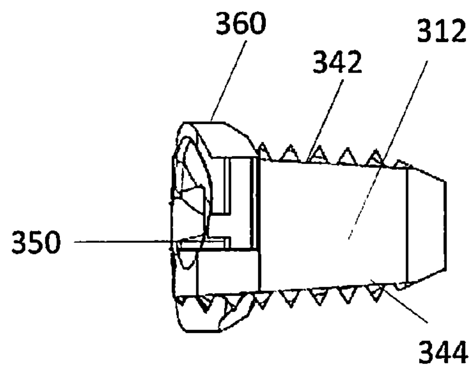


FIG. 5D

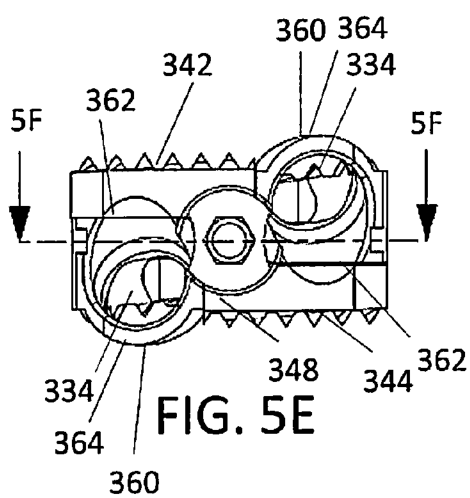


FIG. 5E

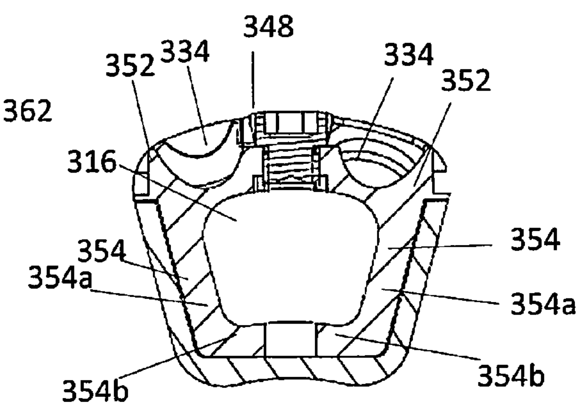


FIG. 5F

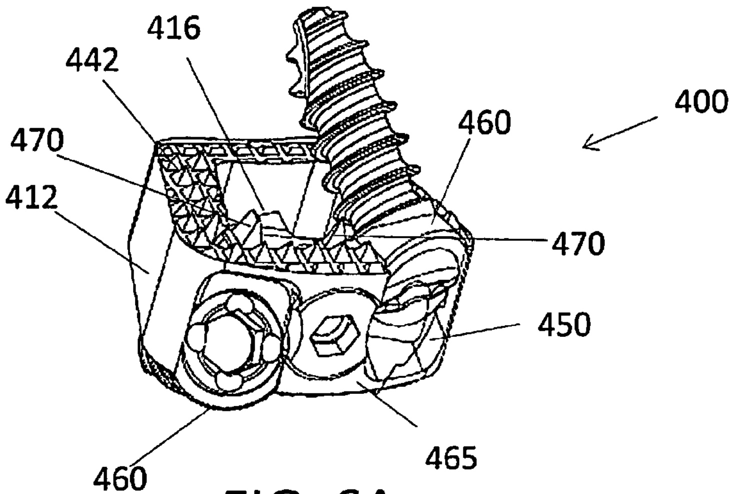
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FIG. 6A

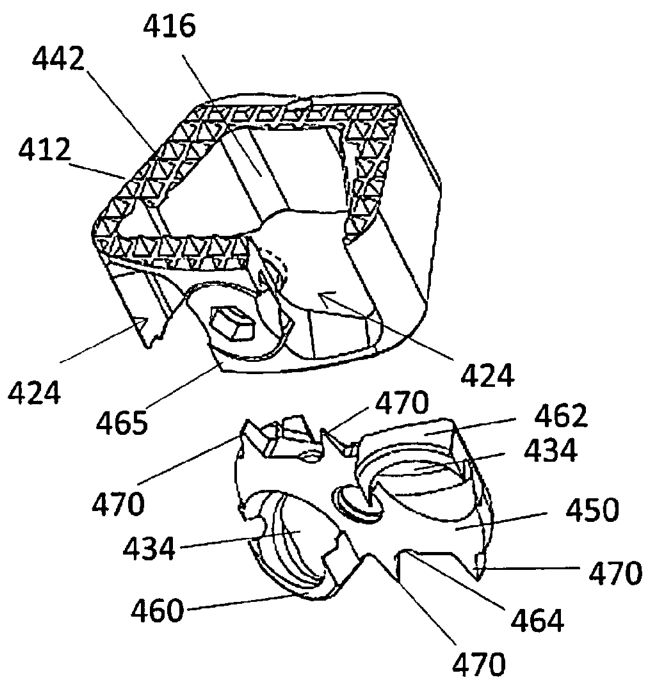
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FIG. 6B

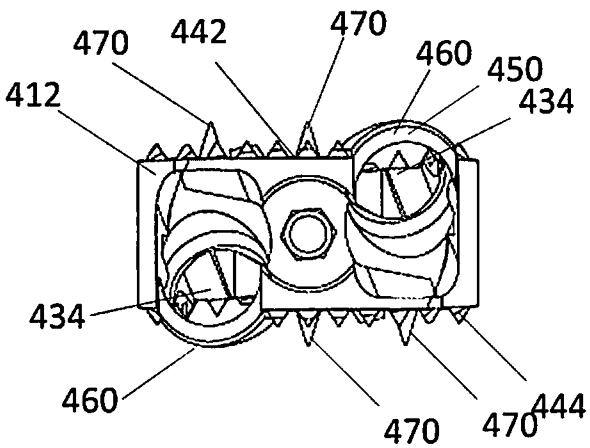


FIG. 6C

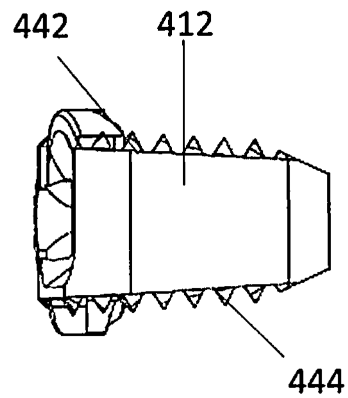


FIG. 6D

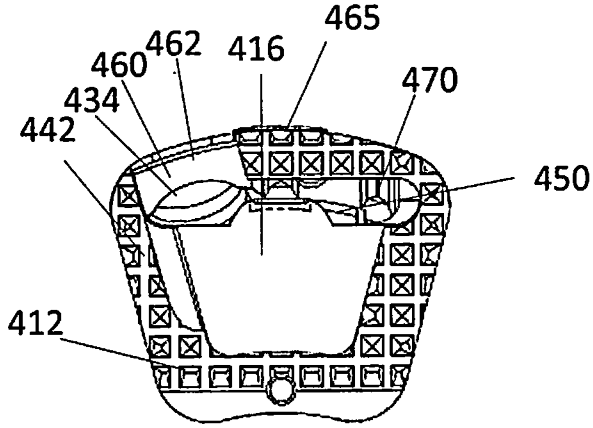


FIG. 6E

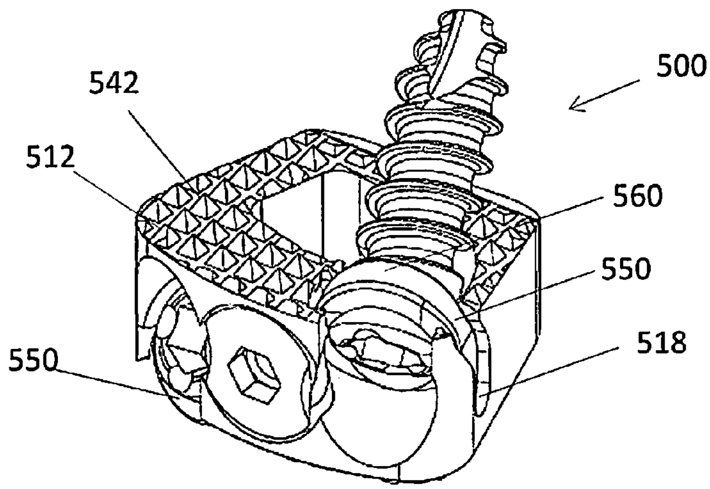
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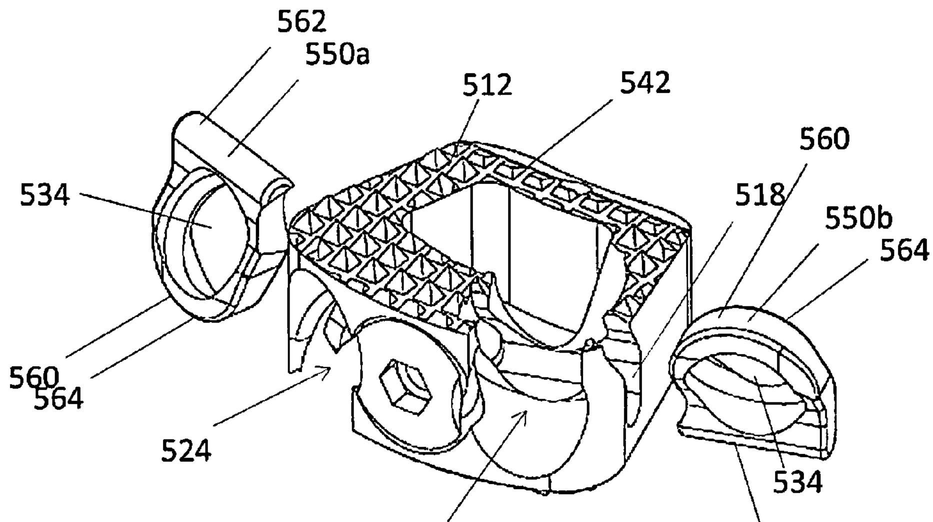
FIG. 7A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550b
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562

FIG. 7B

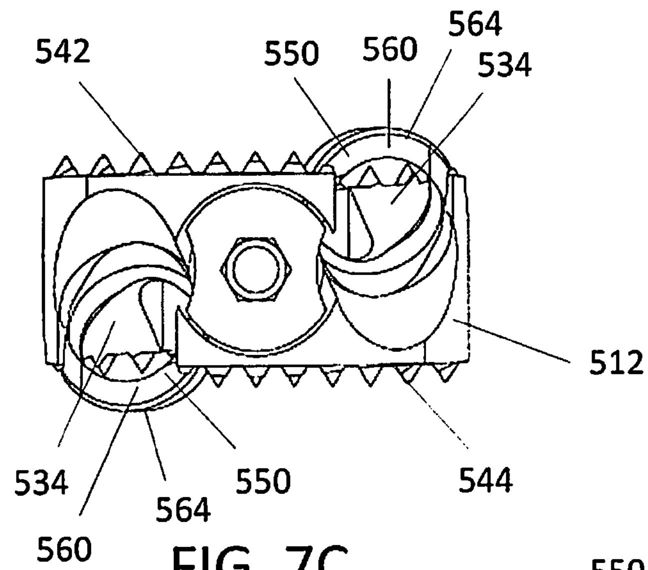



FIG. 7C

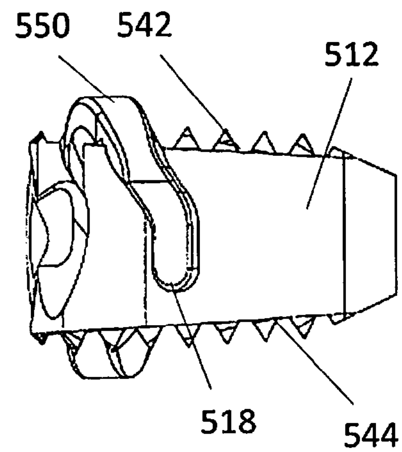



FIG. 7D

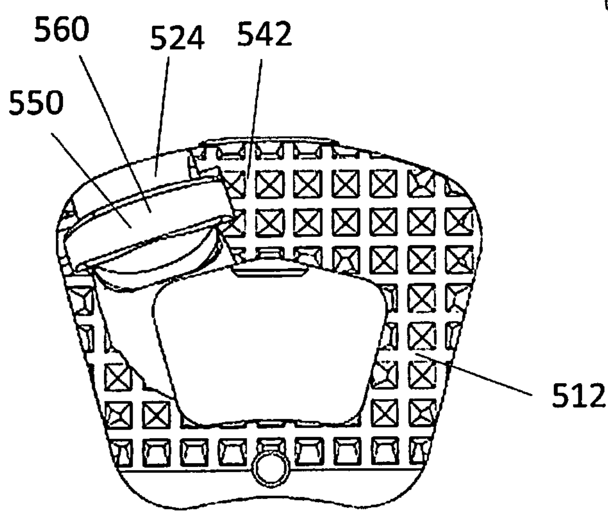



FIG. 7E

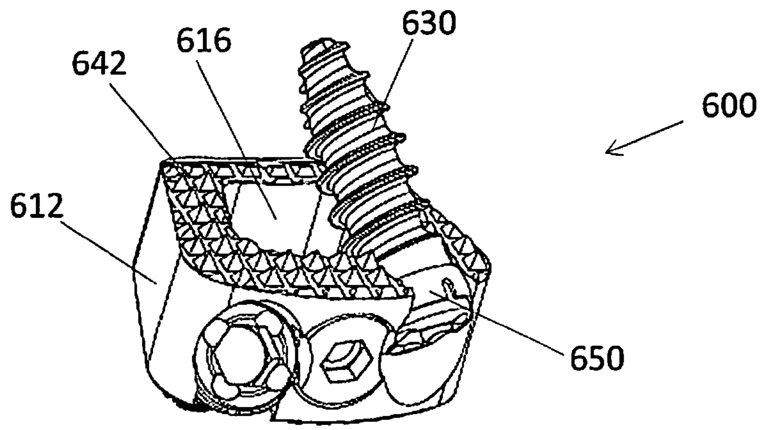



FIG. 8A

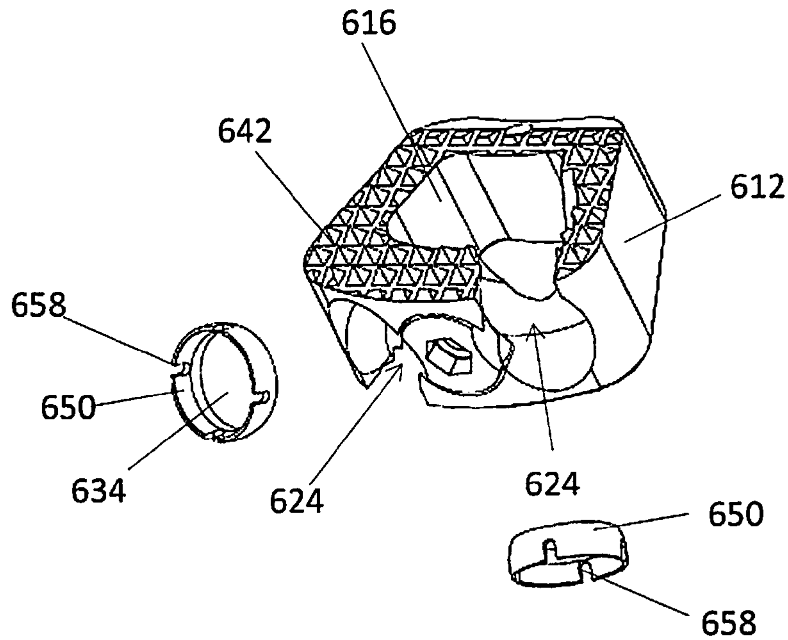



FIG. 8B

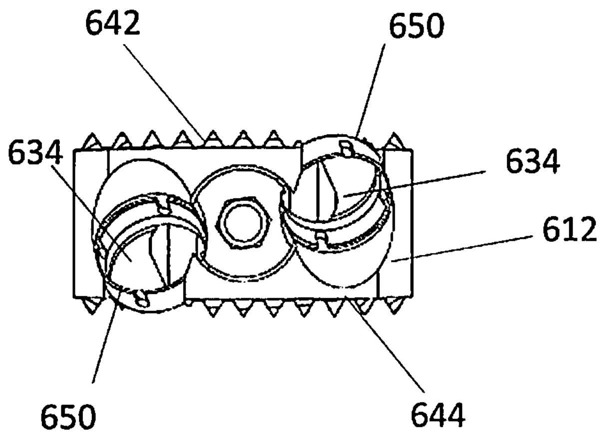



FIG. 8C

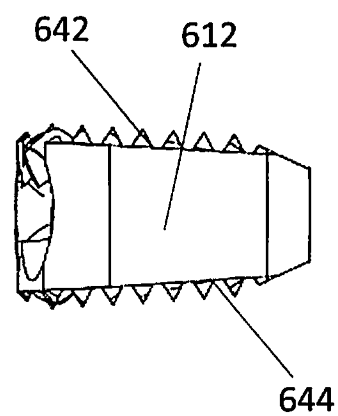



FIG. 8D

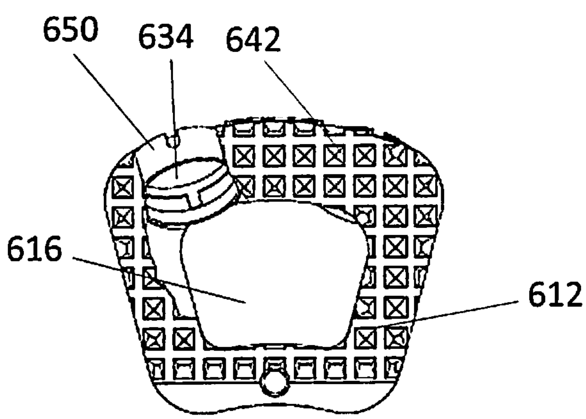



FIG. 8E

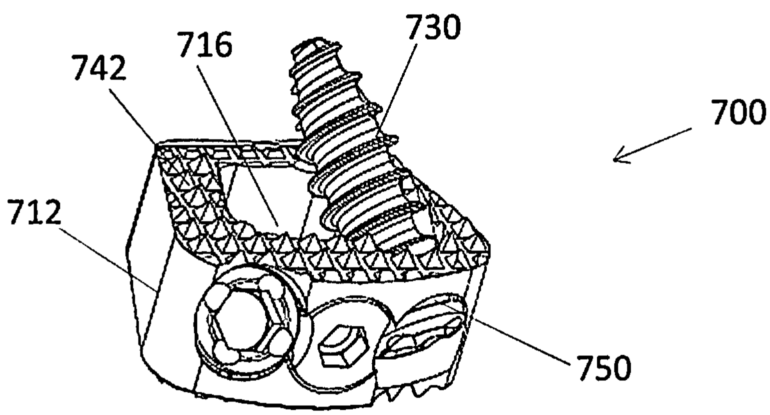



FIG. 9A

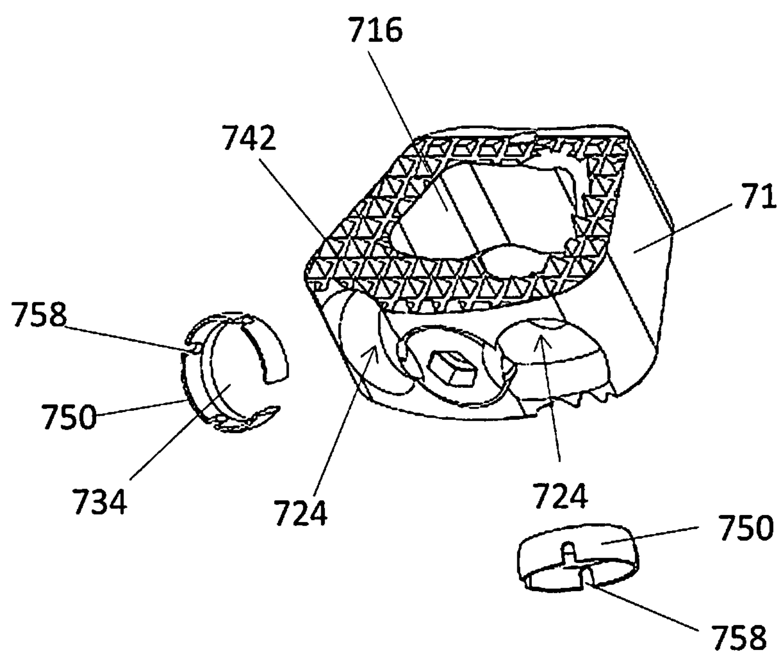



FIG. 9B

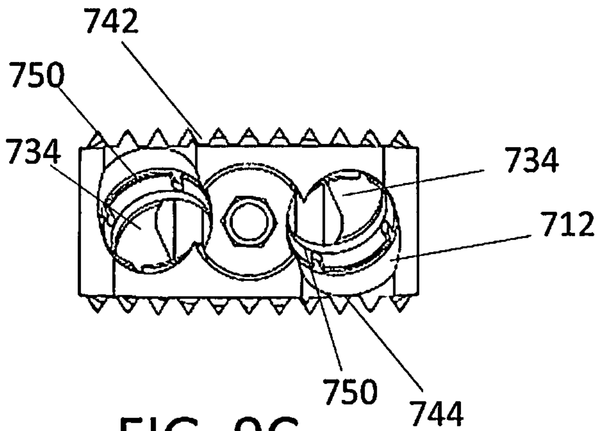



FIG. 9C

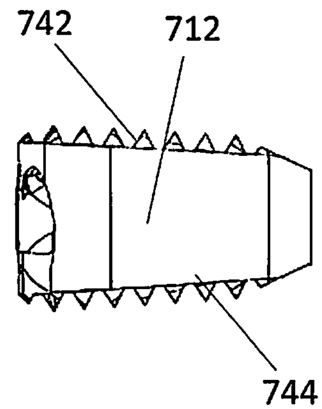



FIG. 9D

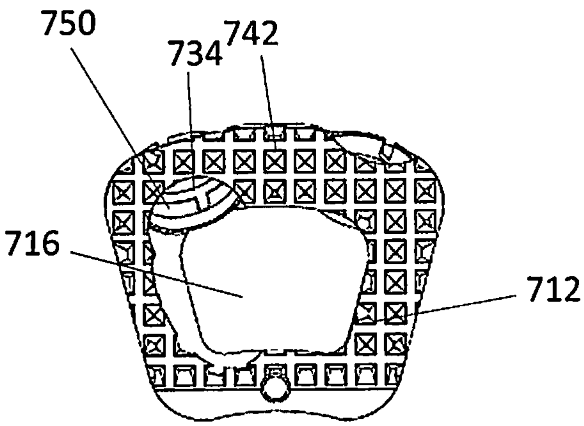



FIG. 9E

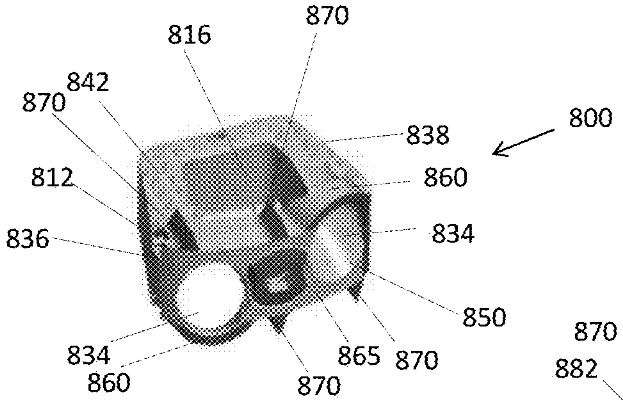



FIG. 10A

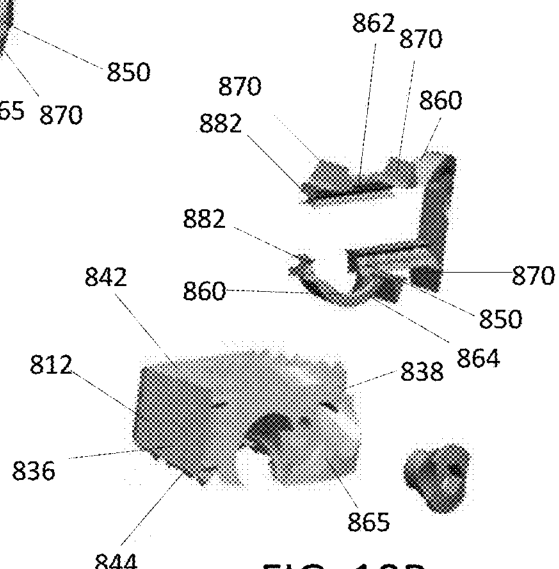



FIG. 10B

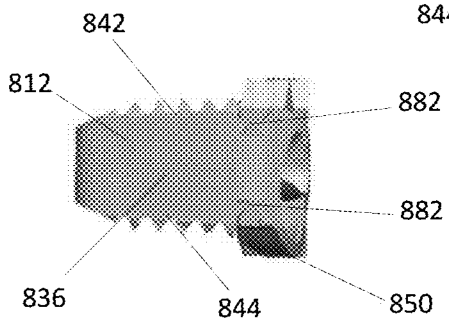



FIG. 10C

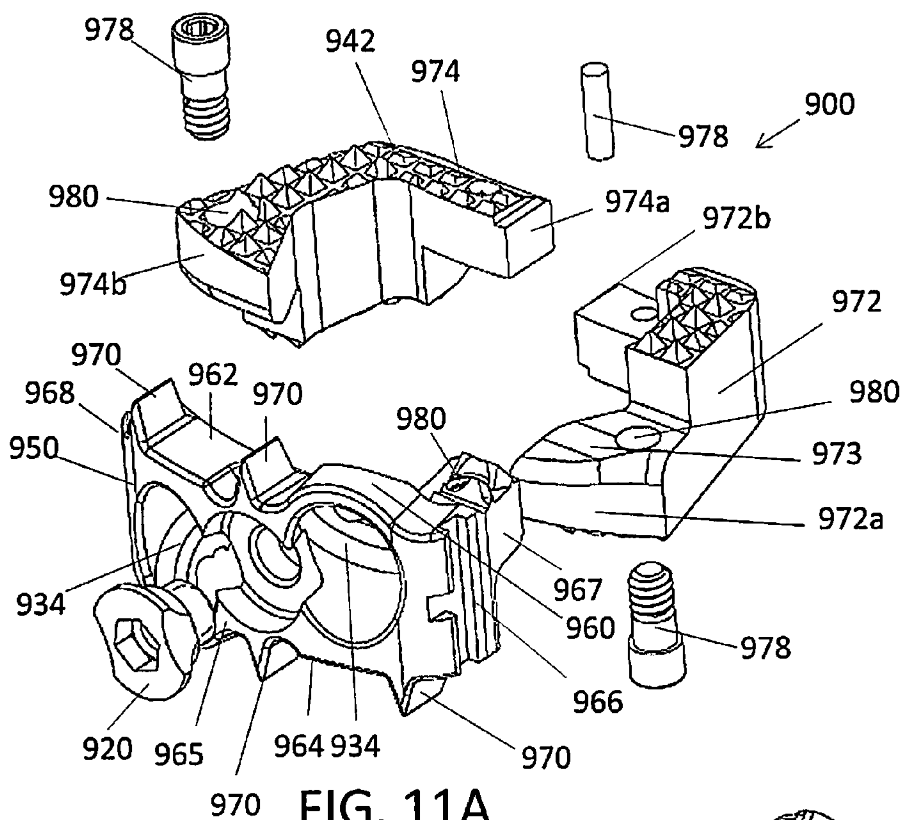


FIG. 11A

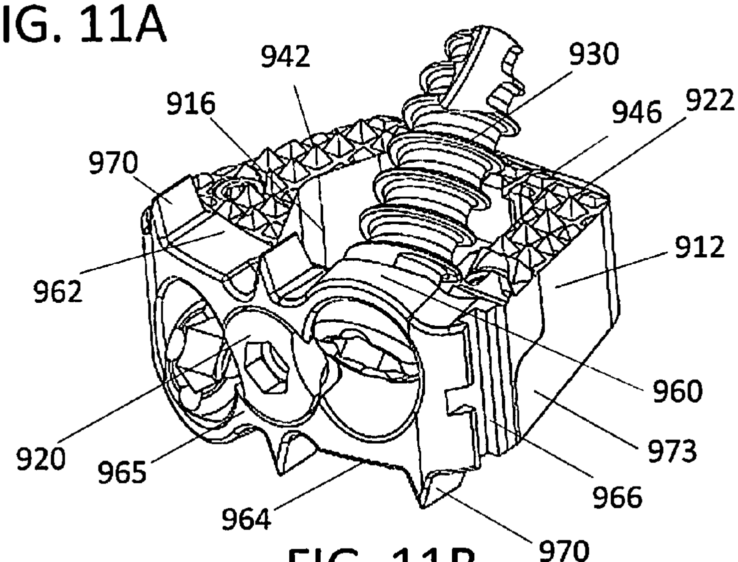


FIG. 11B

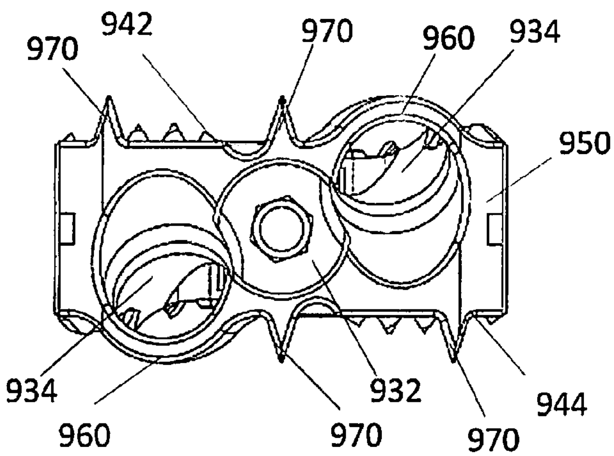



FIG. 11C

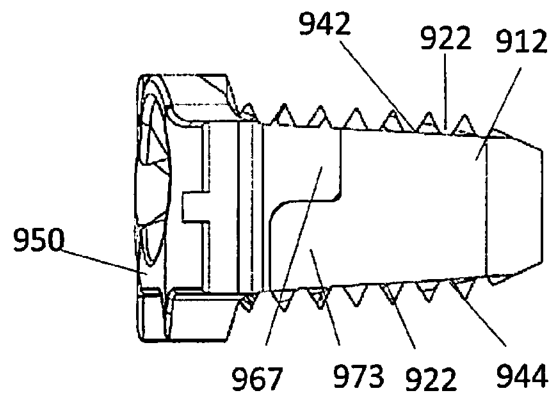



FIG. 11D

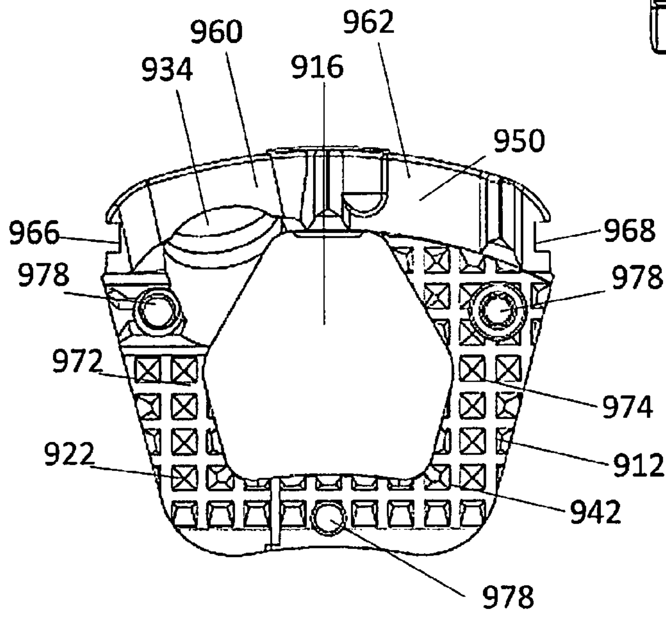



FIG. 11E

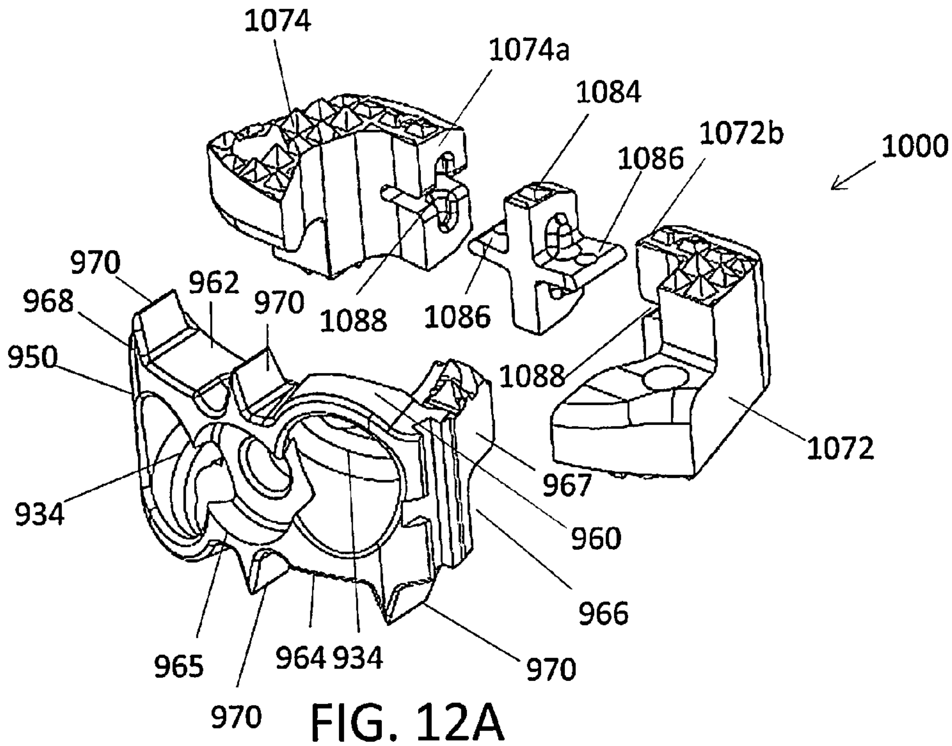



FIG. 12A

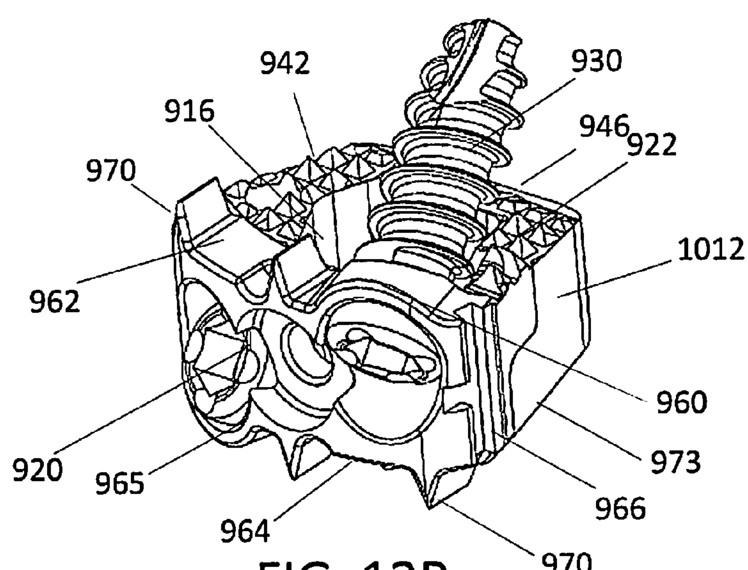



FIG. 12B

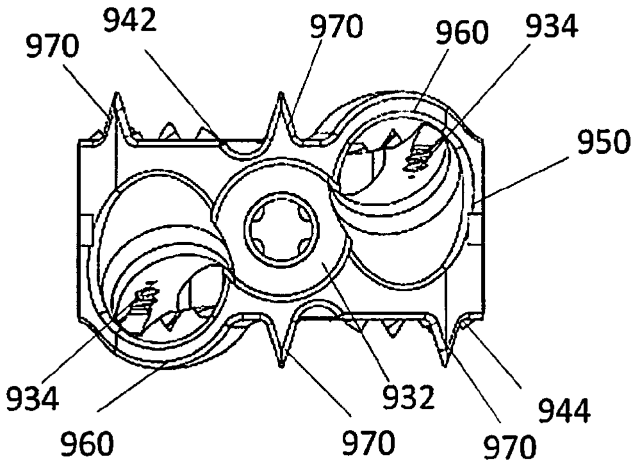



FIG. 12C

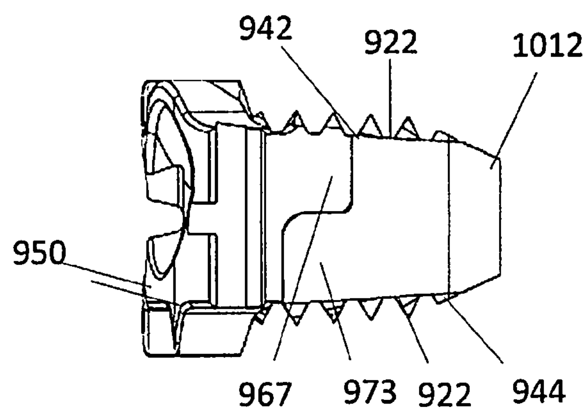



FIG. 12D

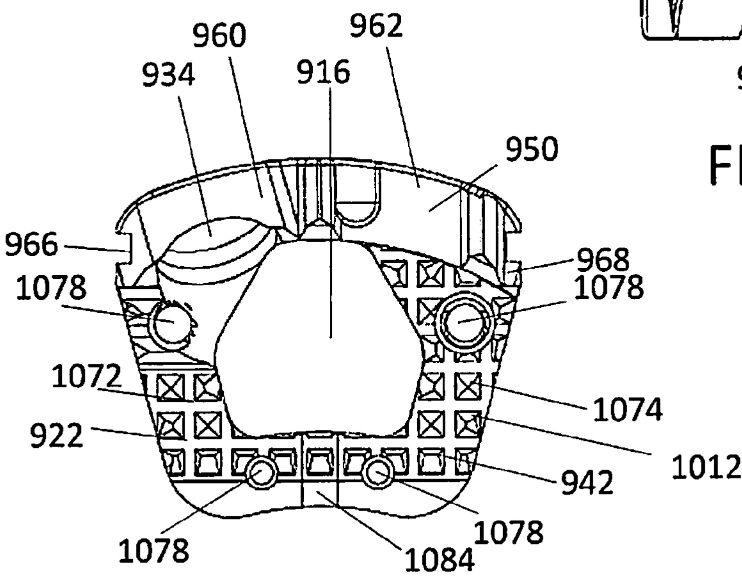



FIG. 12E

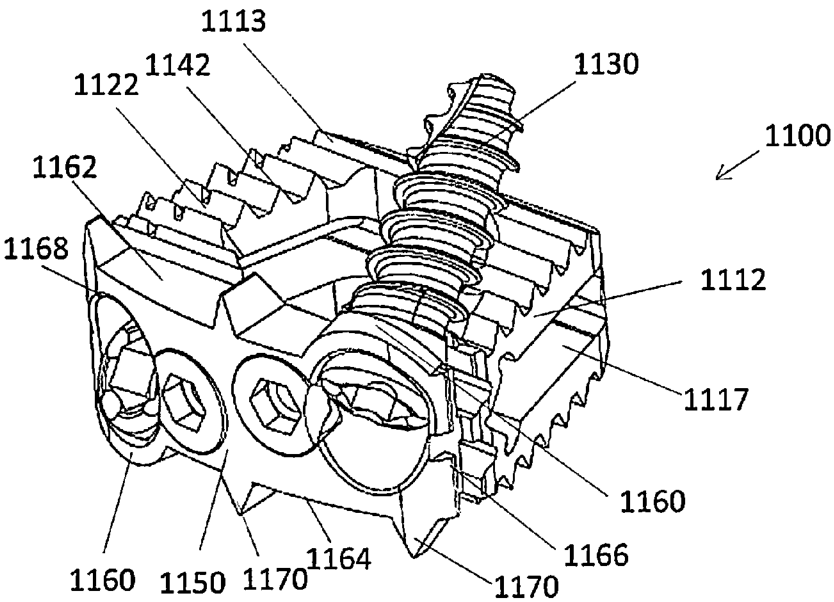



FIG. 13A

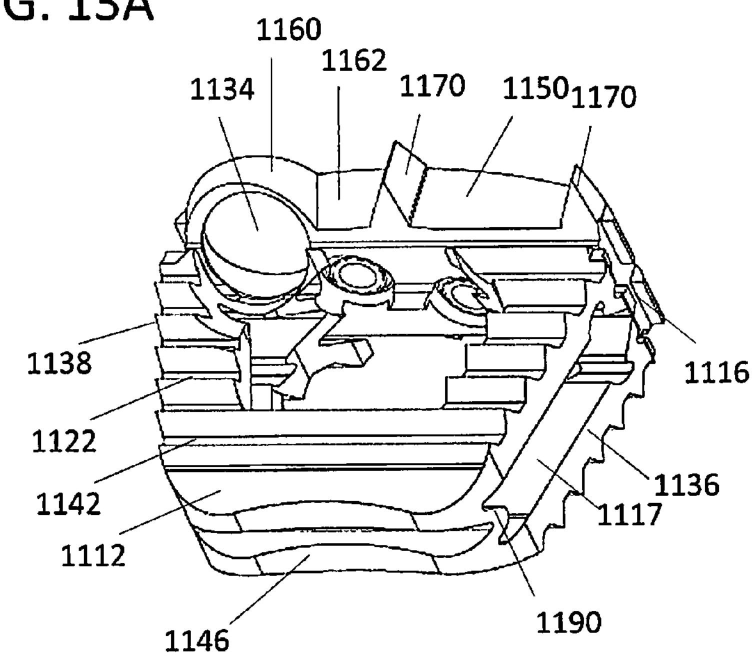



FIG. 13B

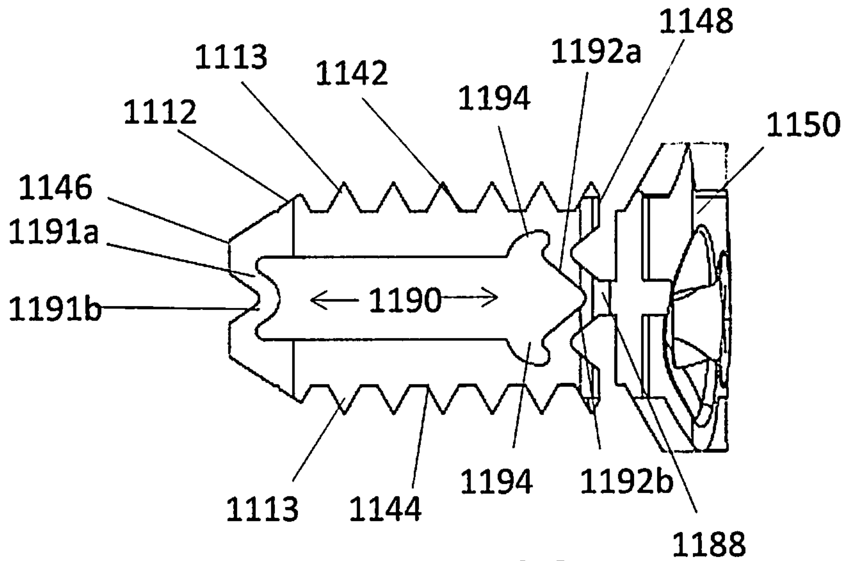



FIG. 13C

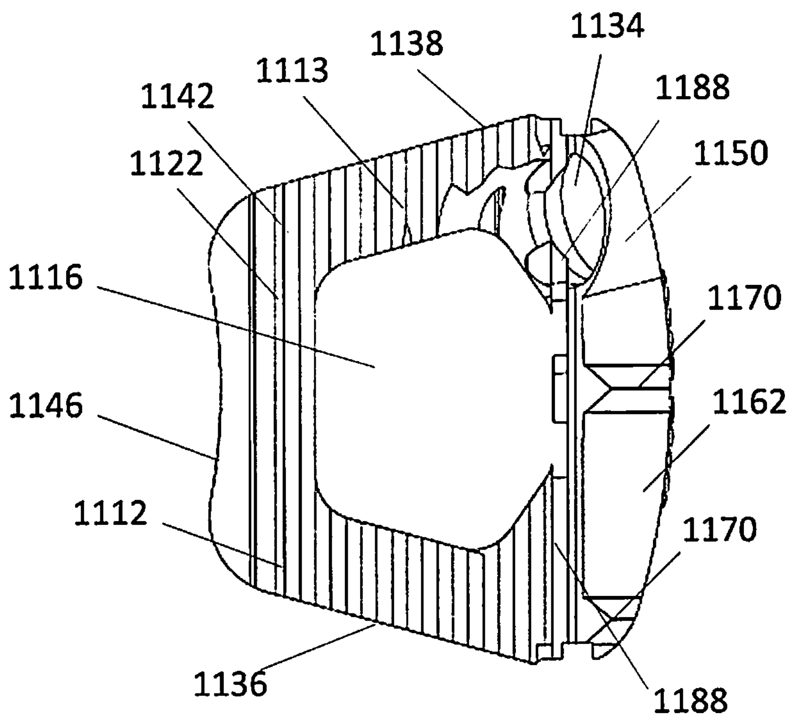



FIG. 13D

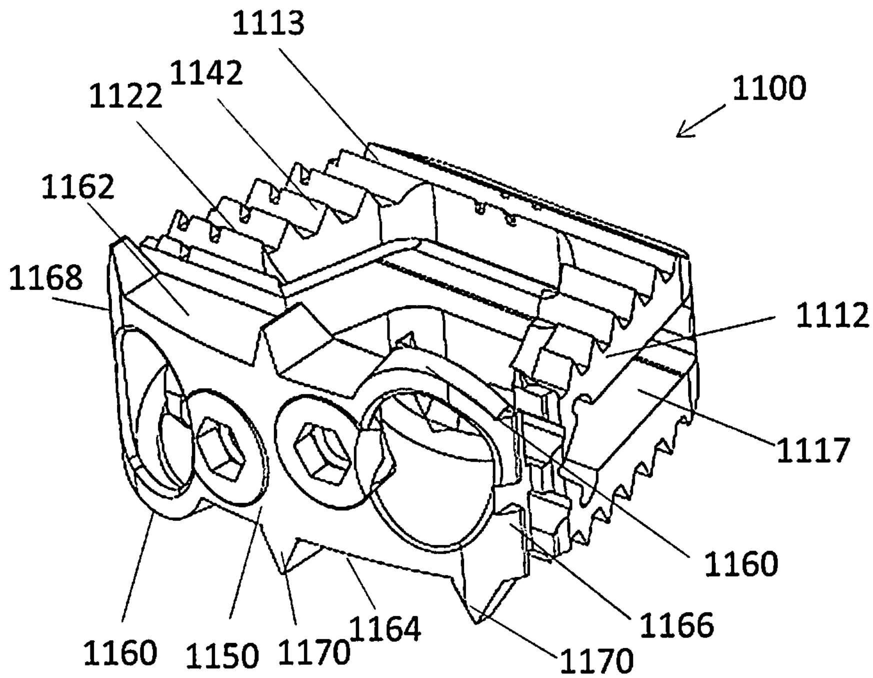



FIG. 13E

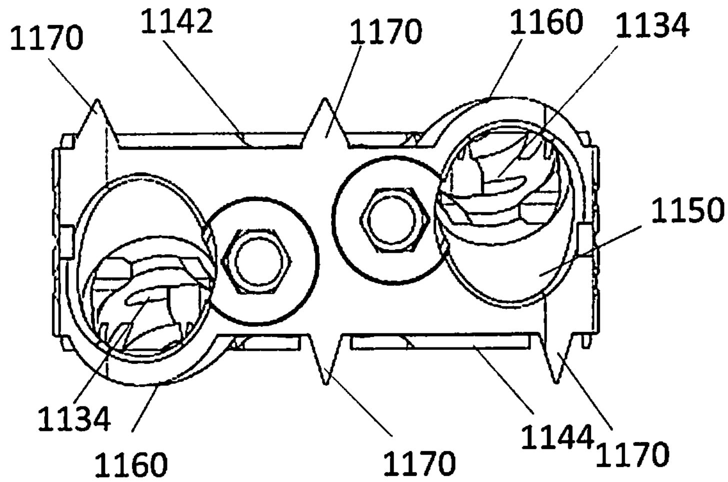
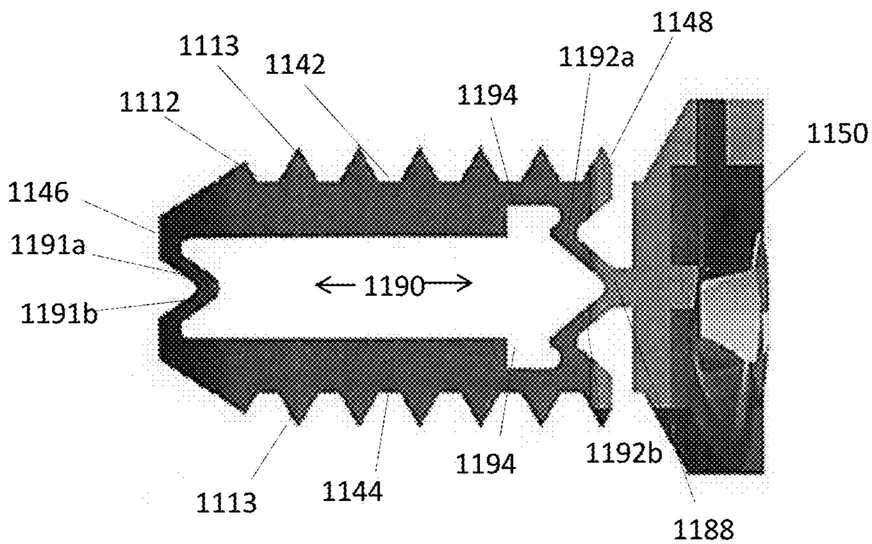



FIG. 13F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1191b
1113
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1194
1192b
1188

FIG. 13G

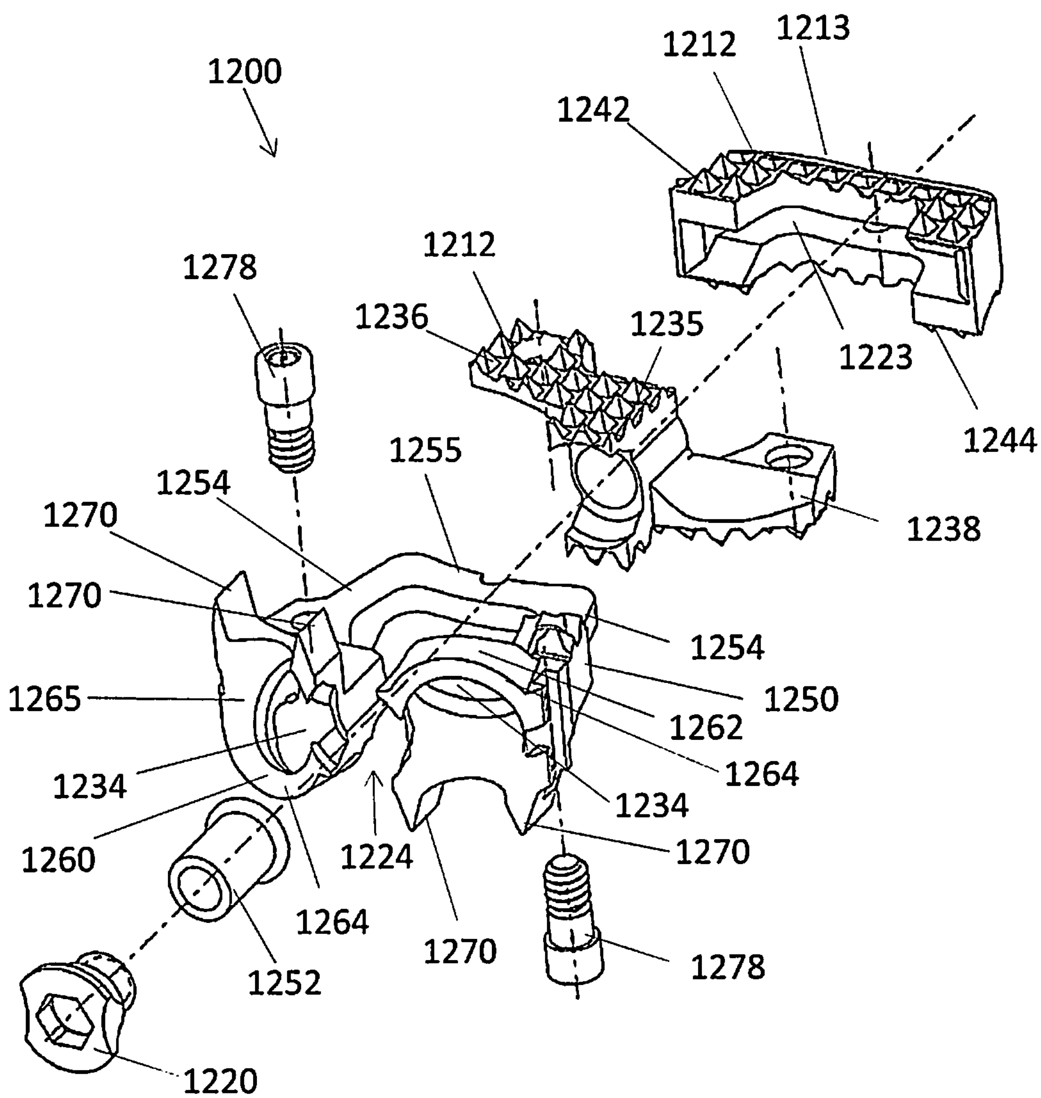
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FIG. 14

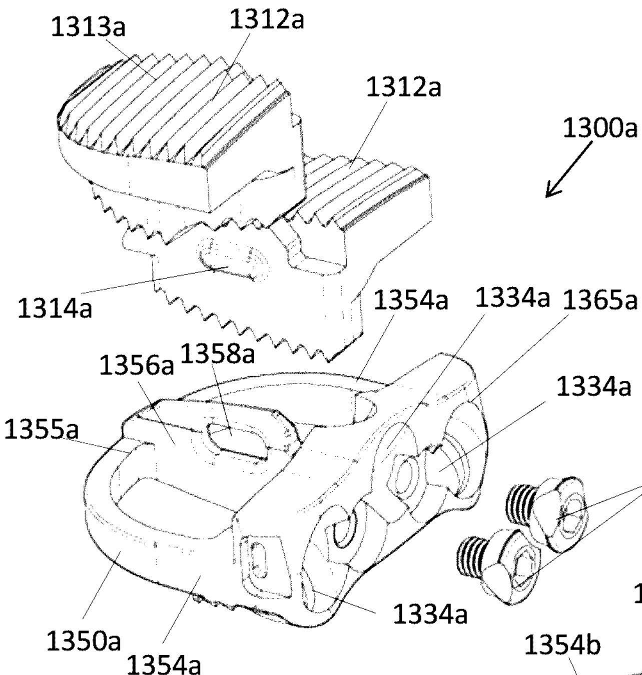


FIG. 15A

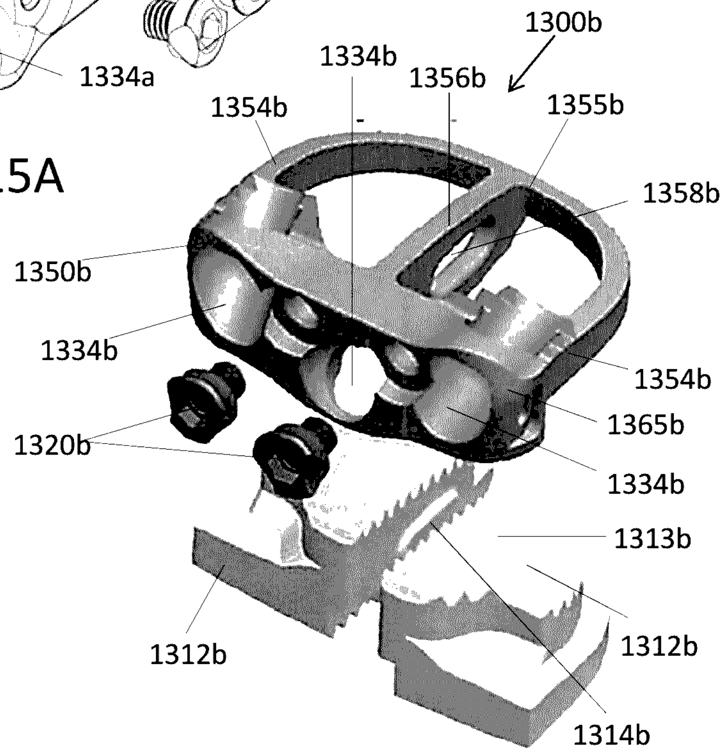


FIG. 15B

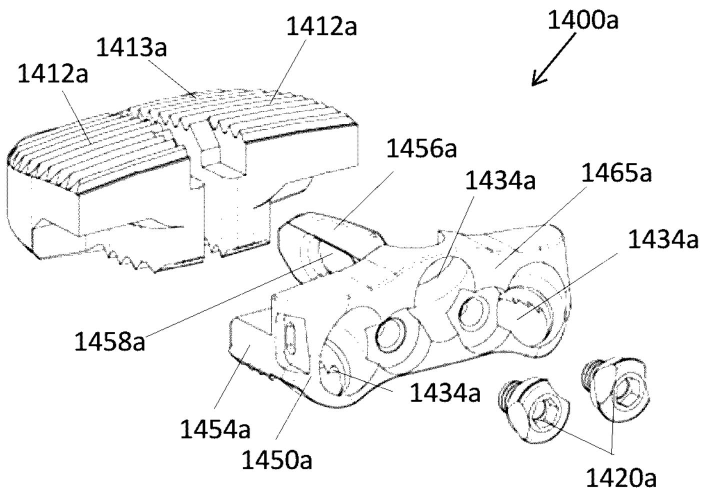


FIG. 16A

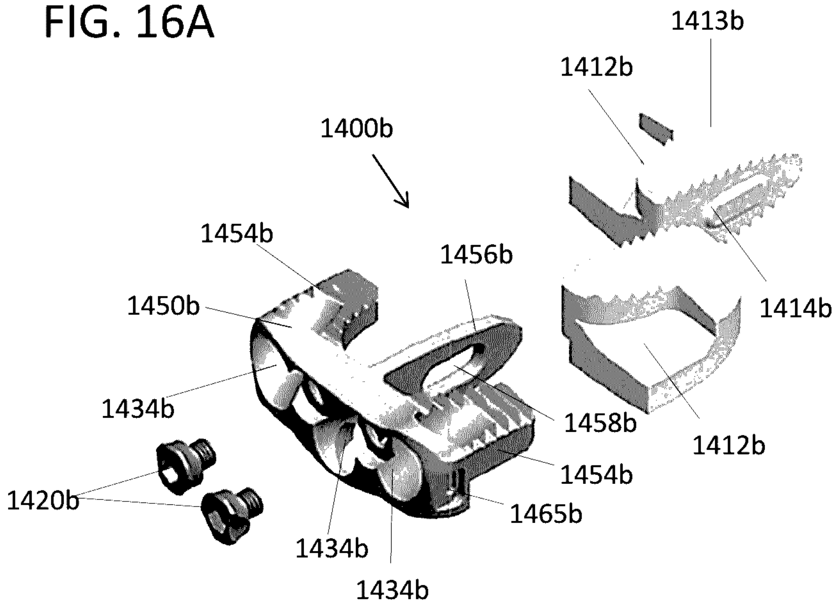


FIG. 16B

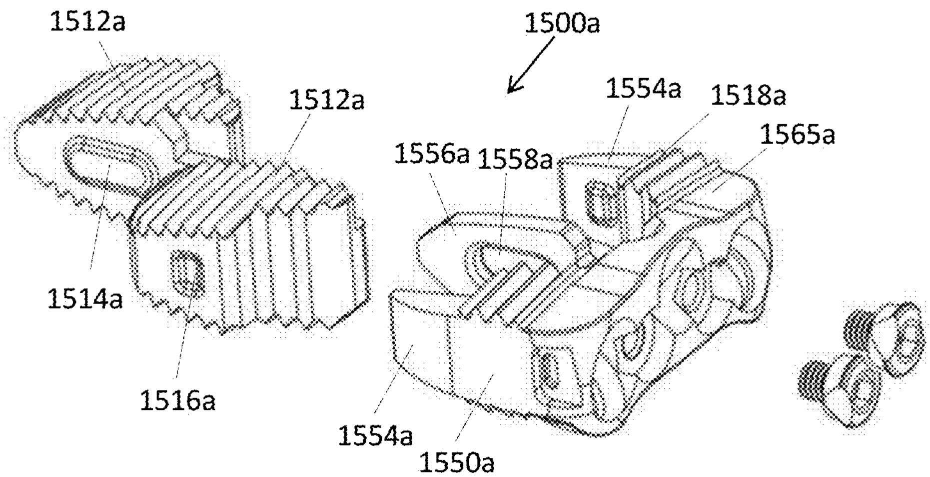


FIG. 17A

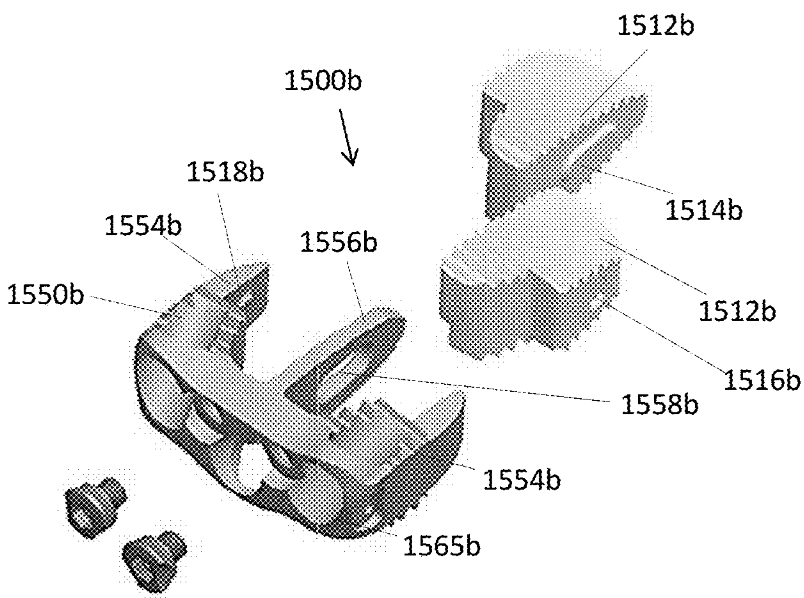


FIG. 17B

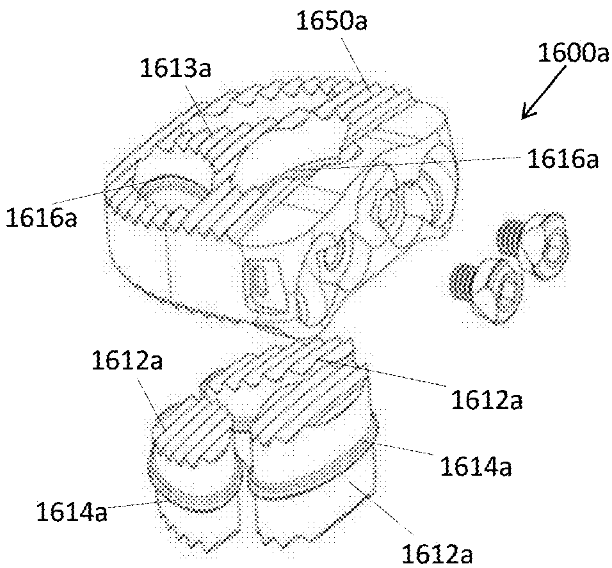


FIG. 18A

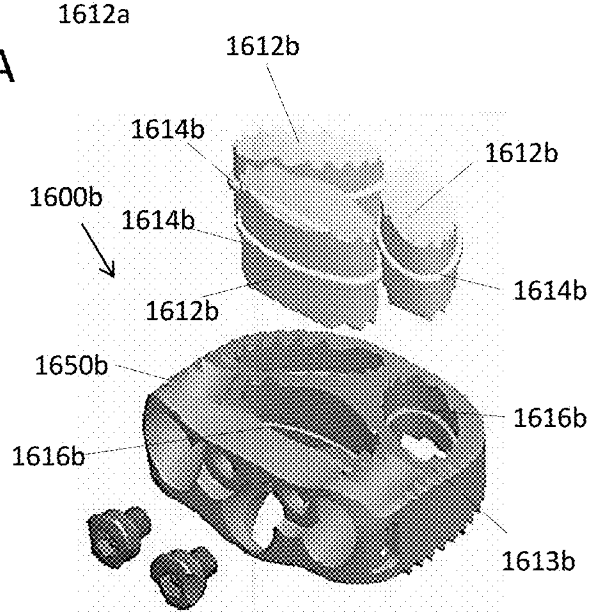


FIG. 18B

# STANDALONE INTERBODY IMPLANTS

## CROSS REFERENCE TO RELATED APPLICATION

The present application is a continuation-in-part of U.S. patent application Ser. No. 14/278,898 filed on May 15, 2014, the entire disclosure of which is incorporated herein by reference in its entirety for all purposes.

## FIELD OF THE INVENTION

The present disclosure generally relates to fixation devices for positioning and immobilizing adjacent vertebral bodies. In particular, the devices may include stand-alone interbody fusion devices.

## BACKGROUND OF THE INVENTION

As people age, the intervertebral discs in the spinal column may start to deteriorate. Subsequently, the intervertebral discs being to lose height. As a result of the loss of height between vertebral bodies, the nerves exiting from the spinal canal become compressed and pinched, which causes pain among other neurological deficits. One solution is to insert a spacer in place of the disc to restore the height and to promote fusion between adjacent vertebral bodies to permanently maintain the height restoration. Additional fixation is also needed to stabilize the spinal segment. A plate is usually provided, and the plate may be positioned on the anterior portions of the adjacent vertebral bodies. In some cases, the profile of the plate becomes obstructive to the anatomy. The approach to the spine is also significant in that a direct anterior approach requires navigation or dissection of vascular anatomy.

As a result, there is a need to provide a spacer having fixation elements to attach the spacer directly to adjacent vertebrae, to limit any profile protruding out of the spine column anteriorly, and to avoid proximal anatomy from a direct anterior approach. The spacer alone, however, may not be strong enough to support fixation elements, such as screws, when the spacer is made solely from certain non-metallic materials, such as, polyether ether ketone (PEEK). Thus, there is also a need for frames or spacers at least partially constructed of strong materials or in such a manner so as to provide additional support for the fixation elements.

## SUMMARY OF THE INVENTION

To meet this and other needs, stand-alone interbody fusion implants and devices are provided. The implants may be provided with a spacer and at least one insert or member. The implants may also be composed of a frame with one or more endplates affixed thereto. The inserts, members, or frames may be especially suited for defining apertures designed to secure fixation elements or fasteners, such as screws, staples, pins, nails, anchors, or the like, and the spacers to adjacent vertebrae. These implants provide for a spine stabilization system that promotes fusion of adjacent vertebrae while at the same time providing stabilization of the spinal area where fusion occurs.

According to one embodiment, an intervertebral implant for implantation in an intervertebral space between adjacent vertebrae includes a spacer and at least one insert. The spacer has a superior surface, an inferior surface, a proximal end, and a distal end. The superior surface and the inferior surface each have a contact area configured to engage adjacent vertebrae. The spacer defines an opening extending from the superior surface to the inferior surface of the spacer. The opening may be configured for receiving bone graft material to promote fusion of the adjacent vertebral bodies. The spacer defines one or more cutout extending from the proximal end to the opening. The spacer may also include a plurality of protrusions on the contact areas of the superior and inferior surfaces for engaging the adjacent vertebrae.

The insert at least partially defines a fastener aperture. These apertures may be in the form of through holes designed, sized, and dimensioned to accommodate and receive fixation devices or fasteners, such as bone screws or anchors. The insert is coupled to the spacer such that at least a portion of the insert is received in the cutout in the spacer.

The insert may be configured in such a way to enhance the strength and stability of the spacer. The insert may extend a distance beyond the superior surface, the inferior surface, or both surfaces of the spacer (e.g., a portion of the insert may extend above or below the superior and inferior surfaces of the spacer). For example, a front surface of the insert may include at least one eyebrow where the eyebrow projects past the superior surface, the inferior surface, or both surfaces of the spacer. The fastener aperture for receiving the fastener may traverse the front surface of the insert at an angle divergent to a horizontal plane in order to help secure the implant to one or both of the adjacent vertebrae.

Unlike a traditional plate, which is typically a thin, flat sheet or strip of material, the insert is provided with a given depth and dimension designed to integrate seamlessly with the spacer. In particular, the depth of the insert may be greater than the width and/or height of the insert. The insert may include a head portion and at least one arm projecting therefrom. The head portion may be enlarged to define the aperture configured for retaining the fastener. The arm may extend laterally, medially, and/or posteriorly away from the head portion. In particular, the arm may extend posteriorly and may be configured to mimic the shape and design of the spacer. The spacer may define at least one recess sized and dimensioned to retain at least a portion of the arm. For example, the arm may rest against a portion of the spacer or a recess therein to form a lap joint, half lap joint, stepped joint, or the like. Any type of joint formed between the insert and the spacer may be secured with one or more pins.

According to another embodiment, the insert may be provided in the shape of a ring, cylinder, c-shape, or the like. The ring or c-shaped insert may be provided with one or more slits, for example, to allow the insert to tightly mate with the cutout through the spacer and secure the insert to the spacer. In particular, one or more slits may be longitudinally positioned around a periphery of the ring or c-shaped insert.

According to yet another embodiment, a stand-alone implant for implantation in a treated area of an intervertebral space between vertebral bodies of a spine includes a spacer and at least one member. The spacer has a first spacer portion and a second spacer portion, each of the first and second spacer portions having a first end and a second end. The second end of the first spacer portion is coupled to the first end of the second spacer portion. The first and second spacer portions form a superior surface and an inferior surface, and the superior surface and the inferior surface each have a contact area configured to engage adjacent vertebrae.

The member has an upper surface, a lower surface, a first lateral portion, a second lateral portion, and at least one hole traversing the member for receiving a fastener. The member is coupled to the spacer such that the first end of the first spacer portion engages the first lateral portion of the member and the second end of the second spacer portion engages the second lateral portion of the member.

The first and second spacer portions may be joined together in any suitable manner. For example, the first and second spacer portions may be mated together by a splice joint, scarf joint, butt joint, or the like. In the alternative or in addition, the first and second spacer portions may be secured together with one or more connectors. For example, the connector may include at least first and second tenons sized and configured to be received within a first mortise in the second end of the first spacer portion and a second mortise in the first end of the second spacer portion. Any type of joint formed between the first and second spacer portions may be further secured with one or more pins or the like.

The spacer portions and the member may also be joined together in any suitable manner. Similar to the insert configuration, the member may rest against a portion of the spacer portions or a recess therein to form a lap joint, half lap joint, stepped joint, or the like. For example, the member may include a first extension extending from the first lateral portion and a second extension extending from the second lateral portion. The first extension may contact a first ledge on the first spacer portion to form a first half lap joint, and the second extension may contact a second ledge on the second spacer portion to form a second half lap joint. If desired, the first and second half lap joints may each be further secured with at least one pin.

According to a further embodiment, an implant for implantation in an intervertebral space between adjacent vertebrae includes a spacer and an anterior portion. The spacer has a superior surface, an inferior surface, a proximal end, and a distal end, for example, configured for insertion into the intervertebral space. The superior surface and the inferior surface each have a contact area configured to engage adjacent vertebrae. The spacer defines an opening extending from the superior surface to the inferior surface of the spacer.

The anterior portion extends from the proximal end of the spacer such that the anterior portion and the spacer are a single piece. The anterior portion has an upper surface, a lower surface, a first lateral portion, a second lateral portion, and at least one hole traversing the anterior portion for receiving a fastener. At least a portion of the upper surface or the lower surface of the anterior portion extends beyond the superior surface or the inferior surface of the spacer. For example, at least one beam may connect the anterior portion to the proximal end of the spacer to form a unitary piece.

The distal end of the spacer may have a first spring feature configured to allow for compression and expansion of the spacer. For example, the first spring feature may be in the form of a v-spring. In addition, the proximal end of the spacer may include a second spring feature. The second spring feature may also be in the form of a v-spring. In particular, the second spring feature may include more than one v-spring oriented in opposite directions. The first and second spring features may be configured such that the spacer simulates the modulus of elasticity of bone even when the spacer and the anterior portion are comprised of titanium.

According to another embodiment, an intervertebral implant for implantation in an intervertebral space between adjacent vertebrae may include a frame and at least one endplate. The frame may include a front portion, a first arm extending from a first end of the front portion, and a second arm extending from a second end of the front portion. The front portion may at least partially define at least one fastener aperture sized and dimensioned for receiving a fastener, such as a bone screw or an anchor. The endplate includes at least one outer surface having a contact area configured to engage adjacent vertebrae. The endplate is affixed to the frame such that the endplate contacts at least a portion of the plurality arms.

The frame may include a support member positioned centrally between the first and second arms. The support member may define at least one opening to retain a corresponding protrusion on the which is configured to provide for a friction fit between the endplate and the frame. The opening may be elongated with a beveled perimeter such that a corresponding protrusion on the endplate is configured to be snapped into the opening in the support member. The endplate may also defines at least one indentation on a lateral portion of the endplate to retain a corresponding protrusion on the first and/or second arms which is also configured to provide an interference fit between the endplate and the frame. The first and second arms may join together at a rear portion to form a ring-like structure.

The endplates may include at least two endplates: a first endplate configured to fit in a first opening between the first arm and the support member and a second endplate configured to fit in a second opening between the second arm and the support member. The endplate may be inserted from the top, bottom, or back of the implant.

The front portion of the frame may be a unitary piece or may be divided into two separate portions with a passage positioned therebetween. The endplate may include a central portion sized and configured to fit within the passage in the front portion. The central portion may define an opening sized and configured to receive an insert which accepts an anti-backout locking mechanism. In addition to the central portion, the endplate may include a first lateral wing and a second lateral wing. The first lateral wing may be configured to contact a portion of the first arm (e.g., forming at least a portion of an upper surface of the implant) and the second lateral wing may be configured to contact a portion of the second arm (e.g., forming at least a portion of a lower surface of the implant).

According to yet another embodiment, the implant may include a frame having a superior surface, an inferior surface, a proximal end, and a distal end, wherein the superior surface and the inferior surface each have a contact area configured to engage adjacent vertebrae, and the frame defines at least one opening extending from the superior surface to the inferior surface of the frame. The frame includes a front surface defining at least one fastener aperture provided at an angle divergent to a horizontal plane for receiving a fastener. The endplates may be sized and configured to fit within the openings in the frame, where the endplates are coupled to the frame by an interference fit and a ridge projecting around an outer perimeter of the endplate sized and configured to be received within a corresponding slot located within the opening. The slot may be located, for example, on a mid-transverse plane of the frame.

In any of the embodiments described herein, the implant may also include a locking mechanism, for example, disposed on the spacer, insert, member, or frame for preventing back out of the screws. For example, a cam-style blocking mechanism may be used with screws that capture the fixation device screws once they are inserted fully into the implant.

The implants may be formed from any suitable biocompatible materials. For example, the implant may be manufactured from a biocompatible metal, such as titanium, polyether ether ketone (PEEK), bone or the like. In one embodiment, the spacer or endplates is formed of a first material and the insert, member, or frame is formed of a second material different from the first material. The insert, member, or frame may be made of a stronger material designed to strength and reinforce one or more openings in the spacer (e.g., designed to retain bone screws) or as attached to the endplates. For example, the spacer or endplates may be formed from PEEK and the insert, member, and frame may be formed from titanium. In the embodiment where the anterior portion and the spacer form a single piece, titanium may be selected for the entire implant because the one or more spring features provide for the spacer to emulate the elasticity of bone.

## BRIEF DESCRIPTION OF DRAWING

The invention is best understood from the following detailed description when read in connection with the accompanying drawing. It is emphasized that, according to common practice, the various features of the drawing are not to scale. On the contrary, the dimensions of the various features are arbitrarily expanded or reduced for clarity. Included in the drawing are the following figures:

FIG. **1**A is a perspective view of a first embodiment suitable for cervical interbody fusion including a spacer with inserts configured to retain bone fasteners when secure to adjacent vertebrae;

FIG. **1**B is a front view of the embodiment shown in FIG. **1**A;

FIG. **1**C is a top view of the embodiment shown in FIG. **1**A;

FIG. **1**D is an exploded view of the embodiment shown in FIG. **1**A;

FIG. **1**E is a lateral view of the embodiment shown in FIG. **1**A;

FIG. **2**A shows a perspective view of an alternative embodiment of an interbody fusion device with inserts;

FIG. **2**B is a top view of the embodiment shown in FIG. **2**A;

FIG. **2**C is an exploded view of the embodiment shown in FIG. **2**A;

FIG. **2**D is a front view of the embodiment shown in FIG. **2**A;

FIG. **2**E is a lateral view of the embodiment shown in FIG. **2**A;

FIG. **3**A is a perspective view of a third embodiment including a spacer with recessed inserts;

FIG. **3**B shows an exploded view of the embodiment shown in FIG. **3**A;

FIG. **3**C shows a front view of the embodiment shown in FIG. **3**A;

FIG. **3**D is a top view of the embodiment shown in FIG. **3**A;

FIG. **3**E is a lateral view of the embodiment shown in FIG. **3**A;

FIG. **4**A shows a perspective view of a fourth embodiment of an implant suitable for lumbar interbody fusion including a spacer with three inserts;

FIG. **4**B is an exploded view of the embodiment shown in FIG. **4**A;

FIG. **4**C is a front view of the embodiment shown in FIG. **4**A;

FIG. **4**D is a bottom view of the embodiment shown in FIG. **4**A;

FIG. **4**E is a lateral view of the embodiment shown in FIG. **4**A;

FIG. **5**A is a perspective view of a fifth embodiment including inserts with head and arm portions;

FIG. **5**B shows an exploded view of the embodiment shown in FIG. **5**A;

FIG. **5**C shows a top view of the embodiment shown in FIG. **5**A;

FIG. **5**D is a lateral view of the embodiment shown in FIG. **5**A;

FIG. **5**E is a front view of the embodiment shown in FIG. **5**A;

FIG. **5**F is a cross-sectional view as designated in FIG. **5**E;

FIG. **6**A is a perspective view of a sixth embodiment including a single insert recessed behind the front portion of the spacer;

FIG. **6**B shows an exploded view of the embodiment shown in FIG. **6**A;

FIG. **6**C is a front view of the embodiment shown in FIG. **6**A;

FIG. **6**D is a lateral view of the embodiment shown in FIG. **6**A;

FIG. **6**E is a top view of the embodiment shown in FIG. **6**A;

FIG. **7**A shows a perspective view of a seventh embodiment with alternative inserts;

FIG. **7**B shows an exploded view of the embodiment shown in FIG. **7**A;

FIG. **7**C is a front view of the embodiment shown in FIG. **7**A;

FIG. **7**D is a lateral view of the embodiment shown in FIG. **7**A;

FIG. **7**E is a top view of the embodiment shown in FIG. **7**A;

FIG. **8**A provides a perspective view of an eighth embodiment where the inserts are in the form of rings;

FIG. **8**B shows an exploded view of the embodiment shown in FIG. **8**A;

FIG. **8**C is a front view of the embodiment shown in FIG. **8**A;

FIG. **8**D is a lateral view of the embodiment shown in FIG. **8**A;

FIG. **8**E is a top view of the embodiment shown in FIG. **8**A;

FIG. **9**A is a perspective view of a ninth embodiment where the inserts have a c-shaped configuration;

FIG. **9**B shows an exploded view of the embodiment shown in FIG. **9**A;

FIG. **9**C is a front view of the embodiment shown in FIG. **9**A;

FIG. **9**D is a lateral view of the embodiment shown in FIG. **9**A;

FIG. **9**E is a top view of the embodiment shown in FIG. **9**A;

FIG. **10**A is a perspective view of a tenth embodiment including a single insert with a clamp-like design;

FIG. **10**B is an exploded view of the embodiment shown in FIG. **10**A;

FIG. **10**C is a lateral view of the embodiment shown in FIG. **10**A;

FIG. **11**A shows an exploded view of an eleventh embodiment including a two-part spacer and a member;

FIG. **11**B shows a perspective view of the embodiment shown in FIG. **11**A;

FIG. **11**C is a front view of the embodiment shown in FIG. **11**A;

FIG. **11**D is a lateral view of the embodiment shown in FIG. **11**A;

FIG. **11**E is a top view of the embodiment shown in FIG. **11**A;

FIG. **12**A shows an exploded view of a twelfth embodiment where the two-part spacer is joined by a connecting member;

FIG. **12**B shows a perspective view of the embodiment shown in FIG. **12**A;

FIG. **12**C is a front view of the embodiment shown in FIG. **12**A;

FIG. **12**D is a lateral view of the embodiment shown in FIG. **12**A;

FIG. **12**E is a top view of the embodiment shown in FIG. **12**A;

FIG. **13**A is a perspective view from an anterior position of a thirteenth embodiment of a single piece implant having an anterior portion and a spacer portion;

FIG. **13**B is another perspective view from a posterior position of the embodiment shown in FIG. **13**A;

FIG. **13**C is a lateral view of the embodiment shown in FIG. **13**A;

FIG. **13**D is a top view of the embodiment shown in FIG. **13**A;

FIG. **13**E is another perspective view of the embodiment shown in FIG. **13**A;

FIG. **13**F is a front view of the embodiment shown in FIG. **13**A;

FIG. **13**G is an alternative version of the embodiment shown in FIG. **13**A;

FIG. **14** is an exploded view of a fourteenth embodiment of an implant having a frame with endplates configured to be affixed thereto;

FIGS. **15**A and **15**B are exploded views of a fifteenth embodiment showing implants having a frame defining a ring-like shape where the endplates are secured with an interference fit;

FIGS. **16**A and **16**B show exploded views of a sixteenth embodiment including implants having a frame including arms and a support member where the endplates are secured with an interference fit;

FIGS. **17**A and **17**B show exploded views of a seventeenth embodiment including implants having a frame including arms and a centrally located support member and two endplates securable with interference features on the support member and the arms; and

FIGS. **18**A and **18**B show exploded views of an eighteenth embodiment having a frame with a plurality of endplates configured to be received within the openings in the frame.

## DETAILED DESCRIPTION OF THE INVENTION

Embodiments of the disclosure are generally directed to stand-alone interbody fusion implants. Specifically, the implants include a spacer combined with at least one insert or member. The inserts or members may be included, for example, to provide openings such as through holes which are designed to retain bone fasteners, such as screws, anchors, staples, pins, nails, and the like. According to other embodiments, the implants include a frame combined with one or more endplates. The frame includes a portion with openings such as through holes which are designed to retain bone fasteners, such as screws, anchors, staples, pins, nails, and the like. The frame may also include arms and an optional support member designed to secure the endplates, for example, with an interference fit.

The embodiments of the disclosure and the various features and advantageous details thereof are explained more fully with reference to the non-limiting embodiments and examples that are described and/or illustrated in the accompanying drawings and detailed in the following description. The features of one embodiment may be employed with other embodiments as the skilled artisan would recognize, even if not explicitly stated herein. Descriptions of well-known components and processing techniques may be omitted so as to not unnecessarily obscure the embodiments of the disclosure. The examples used herein are intended merely to facilitate an understanding of ways in which the disclosure may be practiced and to further enable those of skill in the art to practice the embodiments of the disclosure. Accordingly, the examples and embodiments herein should not be construed as limiting the scope of the disclosure, which is defined solely by the appended claims and applicable law. Moreover, it is noted that like reference numerals represent similar parts throughout the several views of the drawings.

As used herein and in the claims, the terms “comprising” and “including” are inclusive or open-ended and do not exclude additional unrecited elements, compositional components, or method steps. Accordingly, the terms “comprising” and “including” encompass the more restrictive terms “consisting essentially of” and “consisting of.”

Certain embodiments may be used on the cervical, thoracic, lumbar, and/or sacral segments of the spine. For example, the size and mass increase of the vertebrae in the spine from the cervical to the lumbar portions is directly related to an increased capacity for supporting larger loads. This increase in load bearing capacity, however, is paralleled by a decrease in flexibility and an increase in susceptibility to strain. When rigid immobilization systems are used in the lumbar segment, the flexibility is decreased even further beyond the natural motion restriction of that segment. Replacing the conventional rigid immobilization systems with certain embodiments disclosed herein may generally restore a more natural movement and provide added support to the strain-susceptible areas.

FIGS. **1**A-**1**E illustrate different views of one particular embodiment of the stand-alone intervertebral implant **1**. As shown in the perspective view of FIG. **1**A, the implant **1** includes a spacer **12** and one or more inserts **50**. The inserts **50** may be especially designed and configured to define a fastener aperture **34** and/or stabilize, strengthen, and/or reinforce the spacer **12**.

The spacer **12** includes a superior surface **42** and an inferior surface **44**. The superior and inferior surfaces **42**, **44** each have a contact area **22** configured to contact and engage adjacent vertebrae (not shown). The superior and inferior surfaces **42**, **44** may be parallel, curved, or angled to help restore or recreate a lordosis angle (or other angle) of the human spine. In particular, the superior and inferior surfaces **42**, **44** may have a convex curve on the upper and lower surfaces or may be angled from a distal end to a proximal end or from one lateral side to the other to account for curvature of the spine. In addition, the superior and/or inferior surfaces **42**, **44** may be contoured to conform more closely to the concave endplates of the adjacent vertebra.

In order to engage the adjacent vertebrae, the spacer **12** may include a plurality of protrusions **13** or teeth on the contact areas **22** of the superior and/or inferior surfaces **42**, **44**. The protrusions **13** on the superior and inferior surfaces **42**, **44** of each implant **1** grip the endplates of the adjacent vertebrae, resist migration, and aid in expulsion resistance. The plurality of protrusions **13** may be pyramidal in shape, but the protrusions **13** can be configured to be any size or shape to enhance anchoring the spacer **12** and the implant **1** to each of the adjacent vertebrae.

The implant **1** may contain an opening **16**. The opening **16** may be in the form of an axial graft hole within the spacer **12** configured to provide the maximum amount of volume for bone graft packing. The opening **16** may be configured for receiving bone graft material, for example, to promote fusion of the adjacent vertebral bodies. The opening **16** may extend from the superior surface **42** to the inferior surface **44** of the spacer **12** to define a substantially hollow center suitable for retaining one or more bone graft materials. For example, cadaveric bone, autologous bone, bone slurry, BMP, or other similar materials, may enhance tissue growth within the intervertebral space.

The spacer **12** includes a distal end **46** and a proximal end **48**. The distal end **46** of the spacer **12** may include a leading taper **40** for ease of insertion into the disc space. The leading taper **40** may be in the form of a chamfer or a bevel which enables self-distraction of the adjacent vertebral bodies during insertion of the implant **1**. The leading taper **40** may be located along the insertion direction of the implant **1**. For example, the leading taper **40** may assist in an anterior approach to the disc space.

As provided in FIG. **1**D, the spacer **12** defines at least one cutout **24** extending from the proximal end **48** to the opening **16**. In particular, the cutout **24** may be in fluid communication with the opening **16**. The cutouts **24** may also be defined through a portion of the lateral sides **36**, **38** to the opening **16**. The cutouts **24** may be of any suitable shape and configuration, but are preferably sized and dimensioned to receive and retain at least a portion of the insert **50**. For example, the cutout **24** may be sized and dimensioned to receive one or more faces or sides of the insert **50**. The cutout **24** may be uniform or non-uniform and may comprise any morphology of recesses and protrusions configured to mate with the insert **50**, for example, including a male/female mating. For example, the cutout **24** may be defined by one or more stepped projections **26** on the spacer **12**. The cutout **24** may be defined such that the spacer **12** remains a single continuous piece (FIG. **1**D) or the cutout **24** may be defined such that the spacer is broken into separate sections or pieces (not shown).

The insert **50** may be configured to comprise a fastener aperture **34**, which is sized and dimensioned for receiving a fastener, such as a screw **30**. Thus, the implant **1** may be secured to the adjacent vertebrae using fasteners, such as screws, anchors, staples, pins, nails, or the like.

The insert **50** is provided with a given depth and dimension designed to integrate seamlessly with the spacer **12**. In particular, the depth of the insert **50** may be greater than the width and/or height of the insert **50**. In addition, the insert **50** may not span across an entire frontage of the spacer **12**. Instead, the inserts **50** may be provided as discrete units designed to marry with the spacer **12** only at locations needed to reinforce and/or position bone fasteners, such as screws **30**. Thus, the inserts **50** may form only a portion of the front or an area proximate to the front of the implant **1**. In the embodiment shown in FIG. **1**A when two inserts **50** are present, the inserts **50** may be separated a distance apart with a portion of spacer **12** positioned between the two inserts **50**.

A shown in FIG. **1**D, the insert **50** may include a head portion **52** and at least one arm **54** projecting therefrom. The head portion **52** may be enlarged to define the opening or fastener aperture **34** configured for retaining the fastener. The head portion **52** may include a cylindrical portion forming the fastener aperture **34**. The arm **54** may extend from the head portion **52** in one or more directions to contact and integrate with the spacer **12**. For example, the arm **54** may extend laterally, medially, and/or posteriorly away from the head portion **52**. In particular, the arm **54** may extend posteriorly away from the head portion **52** and toward the distal end **46** of the spacer **12** when attached thereto.

The insert **50** including a portion of the arm **54** and/or a portion of the head portion **52** may be configured to mirror the shape and design of the spacer **12**. The spacer **12** may define at least one recess, projection, etc. sized and dimensioned to retain at least a portion of the arm **54**. For example, the arm **54** or any portion of the insert **50** may rest against a portion of the spacer **12** or a recess formed therein to provide a joint, such as a lap joint, half lap joint, dovetail lap joint, beveled lap joint or scarf joint, stepped lap joint, tabled lap joint, or the like. In particular, a lap joint may include joining two pieces of material together by at least partially overlapping them (e.g., at least a portion of the insert **50** and a portion of the spacer **12** are overlapped). In a full lap, no material is removed from either of the members to be joined, resulting in a joint which is the combined thickness of the two members. In a half lap joint, material is removed from each of the members so that the resulting joint is the thickness of the thickest member. In the embodiment shown in FIG. **1**E, the joint portion between the insert **50** and the spacer **12** is at least partially a half lap joint such that the joint does not increase the height of the spacer **12**.

As shown in FIG. **1**E, the insert **50** may join the spacer **12** with a stepped lap joint. A portion of the insert **50** may be stepped with a male projection to mate with a stepped female configuration of the spacer **12**. A series of offset planar surfaces having a rise and a run may form the stepped profile. For example, the arm **54** of the insert **50** may be stepped with a male projection configured to mate with corresponding stepped projections **26** on the spacer **12**. Depending on the configuration of the joint, the joint may form a press-fit or friction-fit engagement to secure the insert **50** to the spacer **12** or the joint may be further secured, for example, with adhesive, pins **78**, or the like.

The insert **50** is coupled to the spacer **12** such that at least a portion of the insert **50** is received in the cutout **24** in the spacer **12**. The spacer **12** and the insert **50** may be coupled, removably coupled, connected, or attached together in any suitable manner known in the art. The spacer **12** and the insert **50** may also be coupled together through appropriate coupling means or fasteners. For example, the insert **50** and cutout **24** may be configured to provide male and female edges, which are the mechanical interfaces between the two pieces. Portions of the spacer **12** and the insert **50** may be assembled together using, alone or in combination, a friction fit, a dovetail assembly, dowel pins, hooks, staples, screws, adhesives, and the like, or any suitable fasteners known in the art, which can be used to permanently attach the spacer **12** and the insert **50** together.

In addition or in the alternative, the spacer **12** and the inserts **50** may be secured together with pins **78** which traverse at least a portion of the spacer **12** and/or the insert **50**. For example, the arm **54** may include one or more openings **80** extending therethrough sized and configured to receive a portion of pin **78**. Similarly, the corresponding portion of the spacer **12** may include one or more openings **80** extending therethrough sized and configured to receive the remainder of pin **78** to secure the arm **54** to the spacer **12**. These openings **80** may or may not be threaded. The pins **78** may pass through holes **80**, for example, in a substantially perpendicular manner relative to a horizontal plane to secure the joint between the insert **50** and the spacer **12**. For example, the pins **78** may be oriented substantially perpendicular relative to the superior and/or inferior surfaces **42**, **44** of the spacer **12**. The pins **78** may be in the form of dowels or may be fully or partially threaded. The pins **78** may be formed from a biocompatible material, such as titanium, or the pins **78** may be formed from tantalum, for example, to enable radiographic visualization.

The head portion **52** of the insert **50** may include an upper surface **62** and a lower surface **64** depending on the orientation of the insert **50**. For example, the two inserts **50** depicted in FIG. **1**D are identical except the inserts **50** are oriented in opposite directions to fit the respective cutouts **24** in the spacer **12**. The first insert **50***a* is oriented such that the upper surface **62** is configured to mate with a portion of the superior surface **42** of the spacer **12** and the lower surface **64** is configured to mate with a portion of the inferior surface **44** of the spacer. Conversely, the second insert **50***b* is oriented such that the lower surface **64** is configured to mate with a portion of the superior surface **42** of the spacer **12** and the upper surface **62** is configured to mate with a portion of the inferior surface **44** of the spacer.

The upper surface **62** and/or lower surface **64** of the head portion **52** of the insert **50** may extend a distance beyond the superior surface **42**, the inferior surface **44**, or both surfaces **42**, **44** of the spacer **12**. In particular, a portion of the head portion **52** of the insert **50** may extend above or below the superior and inferior surfaces **42**, **44** of the spacer **12**. For example, the lower surface **64** of the first insert **50***a* may extend beyond the inferior surface **44** and the lower surface **64** of the second insert **50***b* may extend beyond the superior surface **42** of the spacer **12**.

The projection of the lower surfaces **64** of the first and second inserts **50***a*, **50***b* may be in the form of an eyebrow **60**. The eyebrows **60** may fully capture the bone screws **30** while still allowing for the screw **30** to reside about, below, or above the base plane of the superior and inferior surfaces **42**, **44**. For example, a front surface **65** of the insert **12** may include at least one eyebrow **60** where the eyebrow **60** projects past the superior surface **42**, the inferior surface **44**, or both surfaces **42**, **44** of the spacer **12**. The eyebrow **60** may include a rounded portion. The eyebrow **60** may include a smooth surface or a roughened surface. As shown in FIG. **1**B, the eyebrow **60** may be comprised of a smooth and curved surface. A lateral portion of the eyebrow **60** may further include one or more torsional stabilizers **70** configured to prevent or minimize torsional motion of the implant **1** once implanted. The torsional stabilizers **70** may act as extensions or fins, which may serve as knife edges to further purchase into the bone of the adjacent vertebrae or serve as a stop to abut anterior aspects of the adjacent vertebrae. The torsional stabilizer **70** may include a spiked or pointed projection or extension configured to engage adjacent vertebrae. In particular, the torsional stabilizer **70** may have a width substantially the same or less than a width of the eyebrow **60**.

A portion of each of the upper surfaces **62** of the inserts **50** may also include an additional torsional stabilizer **70**, for example, positioned opposite to the eyebrows **60**. The torsional stabilizer **70** on the upper surfaces **62** may be the same or different than the torsional stabilizer **70** extending from the eyebrows **60**. The upper surfaces **62** of the inserts **50** may complete a surface of the superior and inferior surfaces **42**, **44** of the spacer **12** to enhance anchoring of the spacer **12**. As shown in FIG. **1**D, the spacer **12** may include a notch **23** in the cutout **24** in the superior and/or inferior surfaces **42**, **44** of the spacer **12**. The extension of the upper surface **62** including the torsional stabilizer **70** may fit in this notch **23** to form a continuous and contiguous superior and/or inferior surface for the implant **1**. The notch **23** may be uniform in shape and dimension or non-uniform. In particular, the notch **23** may have a partial rectangular cross-section or may be any suitable shape to compliment the upper surface **62** of the insert **50** and complete the superior and/or inferior surfaces **42**, **44** of the spacer **12**.

Each insert **50** includes a screw hole or fastener aperture **34** sized and dimensioned to receive a fastener, such as screw **30**. The screws **30** may be any suitable screws known in the art including fixed or variable angle. The screw hole **34** is configured to receive the screw **30** at a given angle. For example, the screw holes **34** for receiving the screw **30** may traverse the front surface **65** of the insert **50** at an angle divergent to a horizontal plane in order to secure the implant **1** to one of the adjacent vertebrae. Thus, in the case of implant **1** having two inserts **50** as shown in FIG. **1**A, the screws **30** enter the screw holes **34** at specified angles to enter each of the adjacent vertebrae at the optimal locations. In particular, the screws **30** may be inserted at an angle for maximum screw purchase into the superior and inferior vertebral bodies.

The intervertebral implant **1** may be positioned in the spine after the disc portion between the two vertebral bodies is exposed and removed, for example, using rongeurs or other suitable instruments. The posterior and lateral walls of the annulus are generally preserved to provide peripheral support for the implant **1** and graft materials. A trial device attached to a trial holder may then be inserted into the disc space to determine size of the implant **1**. This procedure is generally conducted using fluoroscopy and tactile feel. The implant **1** may be available in various heights and geometric options to fit the anatomical needs of a wide variety of patients. After the appropriate sized implant **1** is selected and attached to an implant holder and drill guide (not shown), the implant **1** may be inserted into the disc space. Before or after the implant **1** is positioned within the disc space, supplemental graft material can be used to enhance fusion. The implant **1** may be implanted in the vertebral space using an anterior, posterior, lateral, anterolateral, oblique, and/or transforaminal approach. The implant **1** shown in FIG. **1**A may be particularly suitable for an anterior cervical procedure. The implant **1** may be in the form of a stand-alone fusion device to provide structural stability and a low or zero profile design. The implant **1** is preferably assembled before insertion into the disc space.

Once the implant **1** is positioned inside the disc space, an awl or any similar type of instrument, for example, can be used to drill through the screw hole and break the cortex of the adjacent vertebral body. The surgeon performing this procedure may then use a depth gauge to determine the screw length. Once the appropriate screw length is determined, screws **30** may be inserted using a self-retaining screwdriver, for example. Any suitable type of screw **30** may be selected by one of ordinary skill in the art. For example, the screws **30** may include fixed or variable angle screws of any suitable size with appropriate thread spacing, thread pitch, head design, length, and the like.

Once inserted, the screws **30** may be secured with an anti-back out prevention or locking mechanism **20**. The locking mechanism **20** may be in the form of one or more blocking screw **32** to capture the sides of the inserted screws to prevent screw back out. As depicted in FIG. **1**B, the locking mechanism **20** may be disposed on the spacer **12** for preventing back out of the screws **30**. For example, a cam-style blocking mechanism may be used with screws **30** that capture the fixation device screws **30** once they are inserted fully into the inserts **50**. The insert **50** may include a cutout **56** in the outer periphery of the head portion **52** configured such that the locking mechanism **20** may block or unblock the head of the screw **30**. As shown, the anti-back out mechanism **20** may include a single set screw **32** that retains the screws **30** with the implant **1**, although any suitable anti-back out mechanism **20** may be selected by one of ordinary skill in the art.

FIGS. **2**A-**2**E show alternative views of a second embodiment of an implant **10**. In general, most of the structure of implant **10** is similar or comparable to the structure of implant **1**. In this particular embodiment, the torsional stabilizers **70** on the upper surfaces **62** are replaced with a plurality of protrusions **13** or teeth. As shown in FIG. **2**B, a portion of the upper surfaces **62** of the inserts **50***a*, **50***b* may include an extension with a plurality of protrusions **13** or teeth designed to extend the contact areas **22** of the superior and/or inferior surfaces **42**, **44** of the spacer **12**. The protrusions **13** on the upper surfaces **62** of the inserts **50***a*, **50***b* may complete a surface of the superior and inferior surfaces **42**, **44** of the spacer **12** to enhance anchoring of the spacer **12**. As shown in FIG. **2**C, the spacer **12** may include the notch **23** in the cutout **24** in the superior and/or inferior surfaces **42**, **44** of the spacer **12**. The notch **23** may be uniform in shape and dimension or non-uniform. In particular, the notch **23** may have a partial rectangular cross-section. The extension of the upper surface **62** including the plurality of protrusions **13** may fit in this notch **23** to form a continuous and contiguous superior and/or inferior surface for the implant **10**. The plurality of protrusions **13** may be the same or different than the protrusions **13** provided on the remainder of the spacer **12**.

According to a third embodiment, FIGS. **3**A-**3**E show alternative views an implant **100**. In general, most of the structure of implant **100** is similar or comparable to the structure of implant **1**. In this particular embodiment, different inserts **150** are provided. In particular, the upper surfaces **162** of the inserts **150***a*, **150***b* do not include a plurality of protrusions and are instead smooth. These smooth upper surfaces **162** do not complete the superior and inferior surfaces **142**, **144** of the spacer **112**. Instead, the smooth upper surfaces **162** are recessed and mated beneath the superior and inferior surfaces **142**, **144** of the spacer **112**. In addition, the cutouts **124** are modified from those shown in implant **1**. For example, the superior and inferior surfaces **142**, **144** of the spacer **112** are not notched to receive a portion of the insert **150**, but instead extend to the proximal end **48** of the spacer. As is evident in FIG. **3**B, a portion of the stepped projection **126** on the spacer **112** is extended to be contiguous and flush with the proximal end **48** of the spacer **112**.

According to a fourth embodiment, FIGS. **4**A-**4**E show an implant **200**, which may be particularly suitable for an anterior lumbar procedure. In general, most of the structure of implant **200** is similar or comparable to the structure of implant **1**. In this particular embodiment, three different inserts **250** provide the fastener apertures **234**.

A shown in FIG. **4**B, a first insert **250***a* is identical to a second insert **250***b* except as mirror images of one another to fit the respective cutouts **224** in the spacer **212**. The first and second inserts **250***a*, **250***b* each define a fastener aperture **234**. The first and second inserts **250***a*, **250***b* are each configured to allow a bone screw **230** to engage superior or inferior vertebra. Similar to implant **1**, the spacer **212** may include one or more cutouts **224** sized and configured to retain the inserts **250**. The cutouts **224** may further define a stepped projection **226** configured to mate with the arm **254** of the insert **250**. The arm **254** may also be stepped and configured to mate with corresponding stepped projections **226** on the spacer **212**. A portion of the insert **250** may be stepped with a male projection to mate with a stepped female configuration of the spacer **212**. The arm **254** may include a series of offset planar surfaces, for example, having a rise and a run, to form the stepped profile. The cutouts **224** may be in fluid communication with the opening **216** extending from the superior surface **242** to the inferior surface **244** of the spacer **212**.

In addition, the spacer **212** may include one or more notches **223** in the cutout **224** in the superior surface **242** and/or inferior surface **244** of the spacer **212**. The extension of the upper surface **262** of the insert **250** including the plurality of protrusions **213** may fit in the respective notch **223** to form a continuous and contiguous superior surface for the implant **200**. A third insert **250***c* is provided between the first and second inserts **250***a*, **250***b*. The third insert **250***c* is different from the first and second inserts **250***a*, **250***b* and allows a bone screw **230** to engage a superior vertebra. Although the third insert **250***c* is depicted with a smooth upper surface **262**, the third insert **250***c* may also include projections **213**, torsional stabilizers, or the like.

The fastener apertures **234** may be configured such that the locking mechanism **220** may block or unblock the heads of the screws **230** in the respective fastener apertures **234**. As shown, the anti-back out mechanism **220** may include a first set screw **232***a* that is configured to block a portion of the screw **230** in the first insert **250***a* and the screw **230** in the third insert **250***c* and a second set screw **232***b* that is configured to block a portion of the screw **230** in the second insert **250***b* and the screw **230** in the third insert **250***c*.

FIGS. **5**A-**5**F show a fifth embodiment of an implant **300**. In general, most of the structure of implant **300** is similar or comparable to the structure of implant **1**. In this particular embodiment, two different inserts **350** provide the fastener apertures **334**. In this case, modified arms **354** are at least partially received in at least one recess **318** in the spacer **312** to join the insert **350** to the spacer **312**. The recess **318** may extend a set depth into the spacer **312** from the opening **316**. The recess **318** may be in fluid communication with the opening **316**. The recess **318** may be formed in the lateral portions and/or the distal portion of the opening **316**. The recess **318** may be positioned substantially medially between and substantially parallel to the superior and/or inferior surfaces **342**, **344** of the spacer **312**. The recess **318** may be sized and dimensioned to retain at least a portion of the arm **354** of the insert **350**.

The two inserts **350** depicted in FIG. **5**B are identical except are oriented in opposite directions to fit the respective cutouts **324** in the spacer **312**. The insert **350** may include head portion **352** and arm **354** extending therefrom. The arm **354** may extend posteriorly away from the head portion **352** and toward the distal end **346** of the spacer **312** when attached thereto. The arm **354** may be angled relative to the head portion **352** such that the arm **354** is oriented in a medial direction, for example, to mimic the shape of the spacer **312**.

Each arm **354** of the insert **350** may include a first arm portion **354***a* and a second arm portion **354***b*. The first arm portion **354***a* may connect the head portion **352** of the insert **350** to the second arm portion **354***b*. The second arm portion **354** may be angled relative to the first arm portion **354***a*. The first arm portion **354***a* may engage the lateral portions of the recess **318** in the spacer **312**, and the second arm portion **354***b* may engage the distal portion of the recess **318** in the spacer **312**. The upper surface **362** of the insert **350** including the head portion **352**, the first arm portion **354***a*, and the second arm portion **354***b* may be a continuous and contiguous coplanar surface. In the alternative, the arm **354** may be recessed beneath the upper surface **362** of the head portion **352**. The arms **354** of the inserts **350** may join the spacer **312** via a press-fit or friction-fit engagement to secure the insert **350** to the spacer **312** or the joint may be further secured, for example, with adhesive, pins, or the like.

Similar to implant **1**, the lower surface **364** of the head portion **352** of the insert **350** may extend a distance beyond the superior surface **342**, the inferior surface **344**, or both surfaces **342**, **344** of the spacer **312**. For example, the lower surface **364** of the first insert **350***a* may extend beyond the inferior surface **344** and the lower surface **364** of the second insert **350***b* may extend beyond the superior surface **342** of the spacer **312**. The projection of the lower surfaces **364** of the first and second inserts **350***a*, **350***b* may be in the form of eyebrows **360**. In this embodiment, the eyebrow **360** includes a substantially smooth and curved surface. In the embodiment shown, no torsional stabilizers are present, but one or more torsional stabilizers may be added if desired.

Similar to implant **100**, the upper surfaces **362** of the inserts **350***a*, **350***b* do not include a plurality of protrusions and are instead smooth. These smooth upper surfaces **362** do not complete the superior and inferior surfaces **342**, **344** of the spacer **312**. Instead, the smooth upper surfaces **362** are recessed and mated beneath the superior and inferior surfaces **342**, **344** of the spacer **312**. In addition, the cutouts **324** are different from those shown in implant **1**. For example, the superior and inferior surfaces **342**, **344** of the spacer **312** are not notched to receive a portion of the insert **350**, but extend to the proximal end **348** of the spacer.

FIGS. **6**A-**6**E show a sixth embodiment of an implant **400** including a single member **450** recessed behind the front portion of the spacer **412**. In general, most of the structure of implant **400** is similar or comparable to the structure of implant **1**. Unlike the individual inserts **50** provided for each fastener aperture **34** in implant **1**, in this particular embodiment, a single member **450** provides all of the fastener apertures **434**.

In this embodiment, the single member **450** provides two fastener apertures **434** to secure fasteners in both the superior and inferior vertebrae. This member **450** may be provided with or without arms. The member **450** may be recessed in the spacer **412** and positioned posterior to the front surface **465** of the spacer **412**. In particular, the member **450** may be positioned within the opening **416** such that a first portion of the member **450** is received in a first cutout **424** in the spacer **412** and a second portion of the member **450** is received a second cutout **424** in the spacer **412**. The member **450** may be curved and contoured to follow a proximal portion of the spacer **412**.

Similar to implant **1**, the upper and/or lower surfaces **462**, **464** of the member **450** may extend a distance beyond the superior surface **442**, the inferior surface **444**, or both surfaces **442**, **444** of the spacer **412**. For example, a portion of the upper surface **462** of the member **450** may extend above the superior surface **442** and a portion of the lower surface **464** may extend below the inferior surface **444** of the spacer **412**. The projections of the upper and lower surfaces **462**, **464** of the single member **450** may be in the form of eyebrows **460**. In this embodiment, the eyebrows **460** include a substantially smooth and curved surface. In the embodiment shown, torsional stabilizers **470** are provided opposite to the eyebrows **460** and are also provided substantially medially on the member **450** projecting superiorly and inferiorly from both the upper and lower surfaces **462**, **464**, respectively. The torsional stabilizers **470** may include a spiked or pointed projection or extension configured to engage adjacent vertebrae.

According to a seventh embodiment, FIGS. **7**A-**7**E depict an implant **500** with a different type of insert **550**. In general, most of the structure of implant **500** is similar or comparable to the structure of implant **1**. Unlike the inserts **50** provided with arm **54** in implant **1**, in this particular embodiment, the insert **550**, which provides the fastener aperture **534**, does not contain an arm and is directly recessed into at least one slot **518** in the spacer **512**.

The two inserts **550** depicted in FIG. **7**B are identical except are oriented in opposite directions to fit the respective cutouts **524** in the spacer **512**. The insert **550** may be curved or may contain one or more angled transitions. At least a portion of the inserts **550** may join the spacer **512** via a press-fit or friction-fit engagement to secure the insert **550** to the spacer **512** or the joint may be further secured, for example, with adhesive, pins, or the like.

In this embodiment, the inserts **550** are at least partially received in at least one slot **518** in the spacer **512** to join the insert **550** to the spacer **512**. The slot **518** may extend a set depth into the spacer **512** from the cutout **524**. For example, the slot **518** may be formed in an inferior or superior portion of the cutout **524** and may be in fluid communication with the cutout **524**. The slot **518** may include more than one portion including an angled portion, for example. The angled portion may connect the eyebrow **560** to a planar portion. The planar portion may be positioned substantially perpendicular to the superior and/or inferior surfaces **542**, **544** of the spacer **12**. The slot **518** may be sized and dimensioned in any suitable configuration to retain at least a portion of the insert **550**. For example, the upper surface **562** of the insert **550** may contact and fit within the slot **518**. The upper surfaces **562** of the inserts **550** may be substantially smooth or may be textured. The upper surface **562** may also be curved or rounded as shown. These smooth upper surfaces **562** are recessed and mated beneath the superior and inferior surfaces **542**, **544** of the spacer **512**.

In this embodiment, the depth of the insert **550** may be the same or smaller than the depth of the proximal portion of the spacer. In other words, the insert **550** does not need to fill the entire depth of the cutout **524**. As shown in FIG. **7**E, the insert **550** fills only a portion of the cutout **524**. In this embodiment, the insert **550** is positioned substantially centrally in the cutout **524**, but it is envisioned that the insert **550** may be positioned at any suitable location in the cutout **524**.

Similar to implant **1**, the lower surface **564** of the insert **550** may extend a distance beyond the superior surface **542**, the inferior surface **544**, or both surfaces **542**, **544** of the spacer **512**. For example, the lower surface **564** of the first insert **550***a* may extend below the inferior surface **544** and the lower surface **564** of the second insert **550***b* may extend above the superior surface **542** of the spacer **512**. The projection of the lower surfaces **564** of the first and second inserts **550***a*, **550***b* may be in the form of an eyebrow **560**. In this embodiment, the eyebrow **560** includes a substantially smooth and curved surface. In the embodiment shown, no torsional stabilizers are present, but one or more torsional stabilizers may be added if desired.

FIGS. **8**A-**8**E provide an eighth embodiment of an implant **600** where the inserts **650** are in the form of rings. In general, most of the structure of implant **600** is similar or comparable to the structure of implant **1**. In addition, this embodiment is similar to the implant **500** discussed above.

In this embodiment, the insert **650** is in the form of a ring or cylinder. The ring insert **650** may be provided with one or more slits **658**, for example, to allow the insert **650** to tightly mate with the cutout **624** through the spacer **612** and secure the insert **650** to the spacer **612**. In particular, one or more slits **658** may be longitudinally positioned around a periphery of the ring-shaped insert **650**. The slits **658** may be uniformly or non-uniformly positioned around the insert **650**. As shown in FIG. **8**B, the slits **658** may be positioned in 90° increments around the ring insert **650**. For example, four slits **658** may be positioned around the periphery of the ring insert **650**. The slits **658** may be oriented such that the open ends of the slits **658** face anteriorly.

The insert **650** may be received in a recess in the cutout **624** or may be positioned within the cutout **624**. The cutouts **624** may be in fluid communication with the opening **616** extending from the superior surface **642** to the inferior surface **644** of the spacer **612**. The insert **650** may be configured to at least partially define and reinforce the fastener aperture **634**. At least a portion of the inserts **650** may join the spacer **612** via a press-fit or friction-fit engagement to secure the insert **650** to the spacer **612**. The insert **650** may be further secured, for example, with adhesive or the like.

In this embodiment, the depth of the insert **650** may be the same or smaller than the depth of the proximal portion of the spacer. In other words, the insert **650** does not need to fill the entire depth of the cutout **624**. In this embodiment, the insert **650** is positioned at an angle in the cutout **624** to accommodate the angles of the bone screws **630**. It is envisioned that the insert **650** may be positioned at any suitable location in the cutout **624**.

FIGS. **9**A-**9**E provide a ninth embodiment of an implant **700**. In general, most of the structure of implant **700** is similar or comparable to the structure of implant **1**. In addition, this embodiment is substantially the same as the implant **600** discussed above, and the discussion for implant **600** applies equally here. In this particular embodiment, the insert **750** has a c-shaped cross-section instead of being in the form of a ring. The c-shaped inserts **750** shown in FIG. **9**B are the same except are oriented differently. The c-shaped inserts **750** are substantially the same as the ring inserts **650** except a gap separates the insert **750** to allow for further compression and/or expansion of the insert **750**.

The c-shaped insert **750** may also be provided with one or more slits **758**, for example, to allow the insert **750** to tightly mate with the cutout **724** through the spacer **712** and secure the insert **750** to the spacer **712**. In particular, one or more slits **758** may be longitudinally positioned around a periphery of the c-shaped insert **750**. The slits **758** may be uniformly or non-uniformly positioned around the insert **750**. The slits **758** may also positioned in 90° increments around the c-shaped insert **750**. For example, three slits **758** may be positioned around the periphery of the ring insert **750**. The slits **758** may be oriented such that the open ends of the slits **758** face anteriorly.

The insert **750** may be received in a recess in the cutout **724** or may be positioned within the cutout **724**. The cutouts **724** may be in fluid communication with the opening **716** extending from the superior surface **742** to the inferior surface **744** of the spacer **712**. The insert **750** may be configured to at least partially define the fastener aperture **734**. At least a portion of the inserts **750** may join the spacer **712** via a press-fit or friction-fit engagement to secure the insert **750** to the spacer **712**. The insert **750** may also be secured, for example, with adhesive or the like. In this embodiment, the depth of the insert **750** may be the same or smaller than the depth of the proximal portion of the spacer. Similar to insert **650**, the c-shaped insert **750** does not need to fill the entire depth of the cutout **724**. In this embodiment, the insert **750** is positioned at an angle in the cutout **724** to accommodate the angles of the bone screws **730**, but it is envisioned that the insert **750** may be positioned at any suitable location in the cutout **724** so long as the necessary reinforcement is provided to the fasteners.

According to a tenth embodiment, FIGS. **10**A-**10**C provide an implant **800** with a member **850**. In general, most of the structure of implant **800** is similar or comparable to the structure of implant **1**. Unlike the individual inserts **50** provided for each fastener aperture **34** in implant **1**, in this particular embodiment, a member **850** provides all of the fastener apertures **834**. The member **850** may be in the form of a clamp or clip, which surrounds a proximal portion of the spacer **812**.

In this embodiment, the member **850** provides two fastener apertures **834** to secure fasteners in both the superior and inferior vertebrae. This member **850** may be provided with or without arms. The member **850** may be positioned posterior to the front surface **865** of the spacer **812**. In particular, the member **850** may be positioned to surround or envelop a portion of at least one lateral side **836**, **838** and a portion of the superior and/or inferior surfaces **842**, **844** of the spacer **812**. The member **850** may be contoured, for example, to begin at one lateral side **836** wrap around a portion of the superior surface **842** to define one of the fastener apertures **834**, wrap around the other lateral side **838**, wrap under a portion of the inferior surface **844** to define the other fastener aperture **834**, and terminate at the lateral side **836**. The member **850** may begin and terminate at one lateral side **836**, **838**, for example, using one or more clamping features **882**. The clamping features **882** may include prongs or springs which attach or secure the member **850** to the spacer **812**. Although the member **850** is depicted as a single piece, it is envisioned that the clamping member **850** may be comprised of more than one part so long as the member **850** may clamp to the spacer **812** and provide the fastener apertures **834**.

A portion of the upper and/or lower surfaces **862**, **864** of the member **850** may extend a distance beyond the superior surface **842**, the inferior surface **844**, or both surfaces **842**, **844** of the spacer **812**. For example, a portion of the upper surface **862** may extend above the superior surface **842** and a portion of the lower surface **864** may extend below the inferior surface **844** of the spacer **812**. The projections of the upper and lower surfaces **862**, **864** of the single insert **850** may be in the form of eyebrows **860**. In this embodiment, the eyebrows **860** include a substantially smooth and curved surface. In the embodiment shown, torsional stabilizers **870** are also provided substantially medially and laterally on the member **850** projecting superiorly and inferiorly from both the upper and lower surfaces **862**, **864**, respectively. The torsional stabilizers **870** may include a spiked or pointed projection or extension configured to engage adjacent vertebrae.

FIGS. **11**A-**11**E provide an eleventh embodiment of an implant **900**. In general, the structure of implant **900** is similar or comparable to the structure of implant **1**. In this embodiment, the inserts **50** have been replaced with a member **950** and the spacer **912** includes multiple components.

The spacer **912** has a first spacer portion **972** and a second spacer portion **974**. The first spacer portion **972** has a first end **972***a* and a second end **972***b*, and the second spacer portion **974** has a first end **974***a* and a second end **974***b*. The second end **972**$b$ of the first spacer portion **972** is coupled to the first end **974**$a$ of the second spacer portion **974**. The first and second spacer portions **972**, **974** form the superior surface **942** and the inferior surface **944** of the spacer **912**. The superior surface **942** and the inferior surface **944** each have a contact area **922** configured to engage adjacent vertebrae. The first and second spacer portions **972**, **974** and the member **950** join to form an opening **916** extending from the superior surface **942** to the inferior surface **944** of the spacer **912**.

The first and second spacer portions **972**, **974** may be joined together in any suitable manner. For example, the first and second spacer portions **972**, **974** may be mated together by a splice joint, scarf joint, butt joint, or the like. The splice joint may include, for example, a half lap splice joint, a bevel lap splice joint, a tabled splice joint, or the like. In particular, the splice joint may include joining two pieces of material together by at least partially overlapping them (e.g., overlapping at least a portion of the first spacer portion **972** and at least a portion of the second spacer portion **974**). In the embodiment shown in FIG. **11**A, the joint portion between first and second spacer portions **972**, **974** is at least partially a half lap splice joint such that the joint does not increase the height of the spacer **912**. In a half lap splice joint, material is removed from each of the members so that the resulting joint is the thickness of the two members as combined. Although not shown, the splice joint between the first and second spacer portions **972**, **974** may be beveled or scarfed, stepped, notched, keyed, nibbed, or the like. Any type of joint formed between the first and second spacer portions **972**, **974** may be further secured with one or more pins **978** or the like.

The member **950** has an upper surface **962**, a lower surface **964**, a first lateral portion **966**, a second lateral portion **968**, and at least one hole **934** traversing the member **950** for receiving a fastener, such as a screw **930**. The upper surface **962** and/or lower surface **964** may extend a distance beyond the superior surface **942**, the inferior surface **944**, or both surfaces **942**, **944** of the spacer **912**. In particular, a portion of member **950** may extend above or below the superior and inferior surfaces **942**, **944** of the spacer **912**. The projections of the upper and lower surfaces **962**, **964** may each be in the form of an eyebrow **960**. The eyebrow **960** may include a rounded portion, for example, with a smooth surface. The upper and lower surfaces **962**, **964** may further include one or more torsional stabilizers **970** configured to prevent or minimize torsional motion of the implant **900** once implanted. The torsional stabilizers may be positioned, for example, substantially medially and laterally along the length of the member **950**. The torsional stabilizers **970** may include a spiked or pointed projection or extension configured to engage adjacent vertebrae.

The member **950** is coupled to the spacer **912** such that the first end **972**$a$ of the first spacer portion **972** engages the first lateral portion **966** of the member **950** and the second end **974**$b$ of the second spacer portion **974** engages the second lateral portion **968** of the member **950**. The spacer portions **972**, **974** and the member **950** may also be joined together in any suitable manner. The member **950** may be configured to mirror the shape and design of the spacer **912**. The spacer **912** may define at least one recess, projection, etc. sized and dimensioned to retain at least a portion of the member **950**. Similar to the insert configurations discussed in this document, member **950** may rest against a portion of the spacer portions **972**, **974** or a recess therein to form a joint, such as a lap joint, half lap joint, dovetail lap joint, beveled lap joint or scarf joint, stepped lap joint, tabled lap joint, or the like. In particular, at least a portion of the member **950** may at least partially overlap at least a portion of the spacer **912** or vice versa. In the embodiment shown in FIG. **11**A, the joint portions between the member **950** and the spacer **912** are at least partially a half lap joint such that the joint does not increase the height of the spacer **912**.

For example, the member **950** may include a first extension **967** extending from the first lateral portion **966** and a second extension (not visible) extending from the second lateral portion **968**. The first extension **967** and second extension may extend posteriorly away from a front surface **965** of the member **950** and toward the distal end **946** of the spacer **912** when attached thereto. The first extension **967** may contact a first ledge **973** on the first spacer portion **972** to form a first half lap joint. Similarly, the second extension may contact a second ledge on the second spacer portion **974** to form a second half lap joint. The extensions **967** and ledges **973** may be configured to be complimentary and mate together, for example, with planar surfaces, curved surfaces, tapers, bevels, notches, or the like. Depending on the configuration of the joints, the joints may form a press-fit or friction-fit engagement to secure the member **950** to the spacer **912** or the joints may be further secured, for example, with adhesives, pins **978**, or the like. For example, the first and second half lap joints may each be further secured with at least one pin **978**.

When present, the pins **978** may traverse at least a portion of the spacer **912** and/or the member **950**. For example, the extensions **967** may include one or more openings **980** extending therethrough sized and configured to receive a portion of pin **978** to secure the member **950** to the spacer **912**. Similarly, the corresponding portion of the spacer **912** may include one or more openings **980** extending therethrough sized and configured to receive the remainder of pin **978** to secure the member **950** to the spacer **912**. These openings **980** may or may not be threaded. The pins **978** may pass through holes **980**, for example, in a substantially perpendicular manner relative to a horizontal plane to secure the joints between the member **950** and the spacer **912**. For example, the pins **978** may be oriented substantially perpendicular relative to the superior and/or inferior surfaces **942**, **944** of the spacer **912**. The pins **978** may be in the form of dowels (as shown connecting the first spacer portion **972** to the second spacer portion **974**) or may be at least partially threaded (as shown connecting the member **950** to the spacer **912**). The pins **978** may be formed from a biocompatible material, such as titanium, or the pins **978** may be formed from tantalum, for example, to enable radiographic visualization.

The implant **900** may also include a locking mechanism **920** disposed on the member **950** for preventing back out of the screws **930**. For example, a cam-style blocking mechanism may be used with screws **930** that capture the fixation device screws **930** once they are inserted fully through the member **950**. As shown, the anti-back out mechanism **920** may include a single set screw **932** that retain the screws **930** with the implant **900**, although any suitable anti-back out mechanism **920** may be selected by one of ordinary skill in the art.

FIGS. **12**A-**12**E provide a twelfth embodiment of an implant **1000**. In general, most of the structure of implant **1000** is similar or comparable to the structure of implant **1**. In addition, this embodiment is substantially the same as the implant **900** discussed above, and the discussion for implant **900** applies equally here with the same reference numbers provided for unchanged elements. In this particular embodiment, the first and second spacer portions **1072**, **1074** are connected together by a connector **1084** instead of being attached directly to one another. This allows the first and second spacer **1072**, **1074** to be spaced apart with respect to one another. The connector **1084** may also be formed of a material different from the spacer portions **1072**, **1074**, for example, to allow for strength, support, radiographic visualization, or the like.

The first and second spacer portions **1072**, **1074** may be secured together with one or more connectors **1084**. The connector **1084** may be sized, shaped, and configured in any suitable manner to join the second end **1072***b* of the first spacer portion **1072** to the first end **1074***a* of the second spacer portion **1074**. Any of the joints discussed in this document may be suitable to join the first and second spacer portions **1072**, **1074** using connector **1084**.

In the embodiment depicted in FIG. **12**A, the connector **1084** has a substantially t-shaped, plus-shaped, or cross-shaped configuration. For example, the connector **1084** may include at least first and second tenons **1086** sized and configured to be received within mortises **1088** in the spacer portions **1072**, **1074**. For example, a first tenon **1086** projecting laterally from the connector **1084** may be size and configured to be received within a first mortise **1088** in the second end **1072***b* of the first spacer portion **1072** and the second tenon **1086** projecting laterally in the other direction from the connector **1084** may be sized and configured to be received with the second mortise **1088** in the first end **1074***a* of the second spacer portion **1074**.

The tenons **1086** may include additional superior and inferior projections, for example, which mate with a substantially t-shaped, plus-shaped, or cross-shaped mortise **1088**. The mortise and tenon configuration may be of any suitable size, shape, and dimension to join the connector **1084** to the respective spacer portions **1072**, **1074**. As in the other embodiments, the joint may be further secured with one or more pins **1078**. In particular, the pins **1078** may be positioned through each of the tenons **1086** to affix the connector **1084** to the respective spacer portions **1072**, **1074**. The pins **1078** may be positioned through openings **1080** in the tenons **1086** and corresponding openings **1080** in the spacer portions **1072**, **1074**.

According to a thirteenth embodiment shown in FIGS. **13**A-**13**G, a single piece or unitary implant **1100** is provided with an anterior portion **1150** and a spacer portion **1112**. Certain features of implant **1100** are similar or comparable to the structure of implant **1**. In this embodiment, the inserts **50** have been replaced with an anterior portion **1150**, and the spacer **1112** and the anterior portion **1150** form a one piece, standalone design.

The spacer **1112** has a superior surface **1142**, an inferior surface **1144**, a distal end **1146**, a proximal end **1148**, and first and second lateral sides **1136**, **1138**. The superior surface **1142** and the inferior surface **1144** each have a contact area **1122** configured to engage adjacent vertebrae. The contact areas **1122** may include one or more protrusions **1113** on the superior and inferior surfaces **1142**, **1144** of each implant **1100** designed to grip the endplates of the adjacent vertebrae, resist migration, and aid in expulsion resistance. The plurality of protrusions **1113** may be pyramidal in shape and may form a series of ridges and grooves (as shown), but the protrusions **1113** can be configured to be any size or shape to enhance anchoring the spacer **1112** and the implant **1100** to each of the adjacent vertebrae.

The spacer **1112** defines an opening **1116** extending from the superior surface **1142** to the inferior surface **1144** of the spacer **1112** configured to receive bone graft materials. The spacer also defines openings **1117** extending through the lateral sides **1136**, **1138** and into to the opening **1116**. These lateral openings **1117** may be in fluid communication with the central opening **1116**. These openings **1117** may be configured to allow for compression and expansion of the superior and inferior portions of the spacer **1112**.

The distal end **1146** of the spacer **1112** may include a leading taper **1140** for ease of insertion into the disc space. The leading taper **1140** may be in the form of a chamfer or a bevel which enables self-distraction of the vertebral bodies during insertion of the implant **1100**. The leading taper **1140** may be located along the insertion direction of the implant **100**. For example, the leading taper **1140** may assist in an anterior approach to the disc space. The distal end **1146** may also include a groove or recess extending between the lateral sides **1136**, **1138** to facilitate compression and expansion of the implant **1100**.

The anterior portion **1150** has an upper surface **1162**, a lower surface **1164**, a first lateral portion **1166**, a second lateral portion **1168**, and at least one hole **1134** traversing the anterior portion **1150** for receiving a fastener, such as a screw **1130**. At least a portion of the upper surface **1162** or the lower surface **1164** of the anterior portion **1150** extends beyond the superior surface **1142** or the inferior surface **1144** of the spacer **1112**. The projections of upper surface **1162** and/or lower surface **1164** may be in the form of an eyebrow **1160**. The eyebrow **1160** may include a rounded portion having a smooth surface. The upper surface **1162** and/or lower surface **1164** may further include one or more torsional stabilizers **1170** configured to prevent or minimize torsional motion of the implant **1100** once implanted. The torsional stabilizer **1170** may include a spiked or pointed projection or extension, for example, positioned medially and/or laterally on the anterior portion **1150**.

The anterior portion **1150** extends from the proximal end **1148** of the spacer **1112** such that the anterior portion **1150** and the spacer **1112** are a single piece. As a single, unitary piece the anterior portion **1150** and the spacer **1112** may be formed from a single piece of material, such as titanium. By way of example as shown in FIGS. **13**C and **13**D, at least one beam **1188** may connect the anterior portion **1150** to the proximal end **1148** of the spacer **1112** to form a unitary piece. The beam **1118** may extend from a substantially medial position to a lateral position of the spacer **11112**. The beam **1118** may extend across the entire width of the spacer **1112** or a portion thereof. The beam **1118** may be interrupted by a gap, for example, positioned substantially medially. No additional fixation devices or mechanisms are required to attach the anterior portion **1150** to the spacer portion **1112**, but any suitable fixation systems may be selected by one of ordinary skill in the art.

The spacer **1112** includes one or more spring features **1190**, for example, to allow for compression and/or expansion of the implant **1100**. Thus, the spacer **1112** has a flexible nature with flexible sections or portions. In particular, the spring features **1190** are designed such that the spacer **1112** is able to mimic the properties of bone and/or PEEK especially when implanted between adjacent vertebrae. For example, the modulus of elasticity for bone, depending on the type, temperature, strain rate, and other factors, may range from about 0.5-25 GPa. In particular, cancellous bone has a modulus of elasticity of about 0.5-5 GPa. The Young's modulus of PEEK is about 3-4 GPa. Thus, PEEK is often used due to its bone-like modulus of elasticity. A solid block of titanium, on the other hand, has a much higher modulus of about 100-110 GPa. As a replacement to traditional PEEK implants, implant **1100** is provided with spring-like features **1190** such that the implant **1100**, even when formed of titanium, can emulate the modulus of elasticity of cancellous bone. For example, the spacer **1112** may provide for a modulus of elasticity of about 0.5-5 GPa, about 1-5 GPa, about 2-5 GPa, or about 3-4 GPa for the implant **1100**.

The spacer **1112** may provide for additional flexibility and an additional range of motion with respect to the two adjacent vertebrae. For example, the spacer **1112** may allow for at least two degrees of motion depending upon the direction and location of the applied force. In particular, the implant **1100** may allow for forward/anterior or aft/posterior bending and lateral bending to the left or right sides. This type of motion and flexibility may allow for more natural movement of the spinal column.

The spring features **1190** may be of any suitable design or configuration to provide compression and/or expansion of superior and inferior surfaces **1142**, **1144** of the spacer **1112**. For example, the spring feature **1190** may be in the form of a cantilevered v-spring having an elongated solid spring member with a cross-sectional configuration in the form of a V. As shown, the distal end **1146** of the spacer **1112** may have a first spring feature **1190**. For example, the first spring feature **1190** may be in the form of a first v-spring. In addition, the proximal end **1148** of the spacer **1112** may include a second spring feature **1190**. The second spring feature **1190** may also be in the form of a second v-spring. The first and second spring features **1190** may be the same or different. The first and second spring features **1190** may be configured such that the spacer **1112** simulates the modulus of elasticity of bone even when the spacer **1112** and the anterior portion **1150** are comprised of titanium or a titanium alloy.

As shown in FIG. **13**C, the first spring feature **1190** on the distal end **1136** may include two longitudinal walls **1191***a*, **1191***b* provided with an angle therebetween. The angle between the two longitudinal walls **1191***a*, **1191***b* of the v-spring may range from about 45°-170°, about 60°-150°, about 80°-130°, or about 70°-100°, for example. The distal portions of the two longitudinal walls **1191***a*, **1191***b* may be anchored to the superior and inferior portions of the spacer **1112** by additional v-spring configurations. For example, the first longitudinal wall **1191***a* may interface with the superior portion of the spacer **1112** by a v-spring, which is inverted relative to the v-spring provided between the first and second longitudinal walls **1191***a*, **1191***b*. Similarly, the second longitudinal wall **1191***b* may interface with the inferior portion of the spacer **1112** by another v-spring, which is inverted relative to the v-spring provided between the first and second longitudinal walls **1191***a*, **1191***b*. Thus, the first spring feature **1190** provided on the distal end **1136** may include a zig-zag of three v-springs oriented in opposite directions. The angle of the v-spring between the first and second longitudinal walls **1191***a*, **1191***b* may be greater than the angles connecting the respectively longitudinal walls **1191***a*, **1191***b* to the superior and inferior portions of the spacer **1112**.

The implant **1100** may include a second spring feature **1190** on the proximal end **1148** of the spacer **1112**. The second spring feature **1190** may also include two longitudinal walls **1192***a*, **1192***b* provided with an angle therebetween. The angle between the two longitudinal walls **1192***a*, **1192***b* of the v-spring may again range from about 45°-170°, about 60°-150°, about 80°-130°, or about 70°-100°, for example. This angle may be the same, larger, or smaller than the angle between the first and second longitudinal walls **1191***a*, **1191***b* at the distal end **1136**. The apex of the angle may form a junction to connect with the beam **1188**, which connects the spacer portion **1112** to the anterior portion **1150**.

The distal portions of the two longitudinal walls **1192***a*, **1192***b* may be anchored to the superior and inferior portions of the spacer **1112**, respectively by additional v-spring configurations. For example, the first longitudinal wall **1192***a* may interface with the superior portion of the spacer **1112** by a v-spring, which is inverted relative to the v-spring provided between the first and second longitudinal walls **1192***a*, **1192***b*. Similarly, the second longitudinal wall **1192***b* may interface with the inferior portion of the spacer **1112** by another v-spring, which is inverted relative to the v-spring provided between the first and second longitudinal walls **1192***a*, **1192***b*. Thus, the second spring feature **1190** provided on the proximal end **1148** may include a zig-zag of three v-springs oriented in opposite directions. The angle of the v-spring between the first and second longitudinal walls **1192***a*, **1192***b* may be the same or greater than the angles connecting the respectively longitudinal walls **1192***a*, **1192***b* to the superior and inferior portions of the spacer **1112**. Additional recesses **1194** may be provided on the superior and inferior portions of the spacer **1112** to allow for proper movement of the v-springs. In particular, the recesses **1194** may be formed such that the apexes of the upper and lower v-portions are revealed. As shown in FIG. **13**C, the recesses **1194** may be rounded or curved. In an alternative embodiment shown in FIG. **13**G, the recesses **1194** may be angled or pointed.

Although a v-shaped spring is exemplified in this embodiment, the spring portions **1190** may be formed in any suitable shape or configuration not limited to the v-shape, and may include, for example, U-shape, S-shape, coiled, square, rectangular, sinusoidal, corrugated and accordion pleated. In addition, the shape of the spring features **1190** may be symmetrical or non-symmetrical. For example, the longitudinal walls **1191***a*, **1191***b*, **1192***a*, **1192***b* may be symmetrical or non-symmetrical with respect to one another.

According to a fourteenth embodiment shown in FIG. **14**, which may be particularly suitable for an anterior cervical procedure, an implant **1200** including a frame **1250** with one or more endplates **1212** is provided. FIG. **14** depicts an exploded view of the implant **1200**. The frame **1250** may be substantially in the form of a split-ring or partial loop of material with a central opening. When combined with the endplates **1212**, which may be shaped and configured to match the central opening in the frame **1250**, the opening may provide for a graft opening area configured to provide the maximum amount of volume for bone graft packing. The graft area may be configured for receiving bone graft material, for example, to promote fusion of the adjacent vertebral bodies.

The frame **1250** may include a front portion **1265**. The front portion **1265** may define one or more fastener apertures **1234** configured to secure fasteners, such as bone screws (not shown), in both the superior and inferior vertebrae. The front portion **1265** may be a unitary piece or may be divided into two separate portions with a passage or gap **1224** positioned therebetween. The front portion **1265** may include an upper surface **1262** and a lower surface **1264**. A first arm **1254** may extend from a first end of the front portion **1265** and a second arm **1254** may extend from a second end of the front portion **1265** of the frame **1250**. The arms **1254** may join together to form the full or partial ring-like structure. The frame **1250** may also include a rear portion **1255**. The arms **1254** may meet at the rear portion

1255 of the frame 1250, for example. The front portion 1265 may have a height greater than the height of the arms 1250 and the rear portion 1255.

One or more endplates 1212 are positioned on and affixed to the frame 1250 such that at least a portion of the ring portion of the frame 1250 is covered or housed within the endplates 1212. Preferably, the front portion 1265 of the frame 1250 is not covered by the endplates 1212. The endplates 1212 may form a superior surface 1242 and an inferior surface 1244 configured to contact and engage adjacent vertebrae (not shown). The superior and inferior surfaces 1242, 1244 may be parallel, curved, or angled to help restore or recreate a lordosis angle (or other angle) of the human spine. In addition, the superior and/or inferior surfaces 1242, 1244 may be contoured to conform more closely to the concave endplates of the adjacent vertebra.

In order to engage the adjacent vertebrae, the endplates 1212 may include a plurality of protrusions 1213 or teeth on the contact areas of the superior and/or inferior surfaces 1242, 1244. The protrusions 1213 may help to grip the endplates of the adjacent vertebrae, resist migration, and aid in expulsion resistance. The plurality of protrusions 1213 may be pyramidal in shape, but the protrusions 1213 can be configured to be any size or shape to enhance anchoring of the implant 1200 to each of the adjacent vertebrae.

As shown in FIG. 14, two endplates 1212 may be provided. A first endplate 1212 may have a substantially c-shaped configuration designed to follow the shape of the rear portion 1255 of the frame 1350. The endplate 1212 may include a recess or channel 1223 designed and configured to retain at least a portion of the ring and, in particular, at least the rear portion 1255 and a portion of the arms 1254 of the frame 1250. This endplate 1212 may also include a leading taper configured to ease insertion of the implant 1200 into the disc space.

A second endplate 1212 may be provided to at least partially reside within the passage or gap 1224 in the front portion 1265 of the frame 1250. In particular, this endplate 1212 may include a central portion 1235 sized and configured to fit within the gap 1224. The central portion 1235 may form a portion of the superior surface 1242 (e.g., having protrusions 1213 extending superiorly) and a portion of the inferior surface 1244 (e.g., having protrusions 1213 extending inferiorly). In addition, the central portion 1235 may include an opening sized and configured to receive an insert 1252 which accepts an anti-backout locking mechanism 1220. The locking mechanism 1220 may be provided to block or unblock the heads of the fasteners or screws when positioned within the respective fastener apertures 1234. The anti-back out mechanism 1220 may include, for example, a set screw configured to block a portion of the fasteners positioned through the frame 1250.

In addition to the central portion 1235, the endplate 1212 may also include a first lateral wing 1236 and a second lateral wing 1238. The first lateral wing 1236 may be configured to contact a first side of one of the arms 1254 and the second lateral wing 1238 may be configured to contact a second side of the other arm 1254. In this manner, the endplate 1212 may be positioned such that the first lateral wing 1236 forms a portion of the superior surface 1242 (e.g., having protrusions 1213 extending superiorly) and the second lateral wing 1238 forms a portion of the inferior surface 1244 (e.g., having protrusions 1213 extending inferiorly). It is envisioned that the positions of the wings 1236, 1238 may be changed or reversed as one of ordinary skill in the art may recognize.

One or more of the endplates 1212 may be secured to the frame 1250 using any of the mechanisms or techniques described herein. In particular, one or more of the endplates 1212 may be secured with one or more pins 1278. Any suitable number, type, and location for the pins 1278 may be selected. For example, two pins 1278 may be positioned within openings located adjacent to and on opposite sides of the front portion 1265 of the frame 1250.

In this embodiment, the frame 1250 provides two fastener apertures 1234 to secure fasteners, such as bone screws, in both the superior and inferior vertebrae. For example, the fastener apertures 1234 may extend through the front portion 1265 of the frame 1250 at an angle. A portion of the upper and/or lower surfaces 1262, 1264 of the frame 1250 may extend a distance beyond the superior surface 1242, the inferior surface 1244, or both surfaces 1242, 1244 of the endplates 1212. The projections of the upper and lower surfaces 1262, 1264 of the frame 1250 may be in the form of eyebrows 1260. In this embodiment, the eyebrows 1260 include a substantially smooth and curved surface. One or more torsional stabilizers 1270 may also be provided and configured to prevent or minimize torsional motion of the implant 1200 once implanted. The torsional stabilizers 1270 may include a spiked or pointed projection or extension configured to engage adjacent vertebrae.

According to a fifteenth embodiment shown in FIGS. 15A and 15B, which may be particularly suitable for an anterior lumbar procedure, implants 1300*a*, 1300*b* include a frame 1350*a*, 1350*b* with one or more endplates 1312*a*, 1312*b*. FIGS. 15A and 15B depict exploded views of the implants 1300*a*, 1300*b*. The frames 1350*a*, 1350*b* may be substantially in the form of a ring or loop of material with a central opening divided into two equal halves. The endplates 1312*a*, 1312*b*, for example, in the form of PEEK or allograft spacers, may be sized and configured to fit within the openings.

The frames 1350*a*, 1350*b* may each include a front portion 1365*a*, 1365*b*, which defines one or more fastener apertures 1334*a*, 1334*b* configured to secure fasteners, such as bone screws (not shown), in both the superior and inferior vertebrae. The front portion 1365*a*, 1365*b* may extend from a first lateral end to a second lateral end of the frame 1350*a*, 1350*b*. A first arm 1354*a*, 1354*b* may extend from a first end of the front portion 1365*a*, 1365*b* and a second arm 1354*a*, 1354*b* may extend from a second end of the front portion 1365*a*, 1365*b* of the frame 1350*a*, 1350*b*. The arms 1354*a*, 1354*b* may join together to form the ring-like structure of the frame 1350*a*, 1350*b*. The frame 1350*a*, 1350*b* may include a rear portion 1355*a*, 1355*b* where the arms 1354*a*, 1354*b* connect together.

In this embodiment, the frame 1350*a*, 1350*b* provides three fastener apertures 1334*a*, 1334*b* to secure fasteners, such as bone screws, in both the superior and inferior vertebrae. For example, the fastener apertures 1334*a*, 1334*b* may extend through the front portion 1365*a*, 1365*b* of the frame 1350*a*, 1350*b* at an angle. As described herein, once inserted through the fastener apertures 1334*a*, 1334*b*, the fasteners may be secured with an anti-back out prevention or locking mechanism 1320*a*, 1320*b*, such as by using one or more blocking screw to capture a portion of the fasteners to prevent back out.

The frame 1350*a*, 1350*b* may also include a support member 1356*a*, 1356*b*. The support member 1356*a*, 1356*b* may divide or segment the central opening and provide stability to the frame 1350*a*, 1350*b*. As shown, the support member 1356*a*, 1356*b* may be a medial portion of the implant 1300*a*, 1300*b*, which is positioned centrally to divide the central opening into two equal halves. It is envisioned, however, that the support member **1356***a*, **1356***b* may be absent creating a single large opening, the support member **1356***a*, **1356***b* may be offset such that the two openings are not equal in size, or more than one support member **1356***a*, **1356***b* may be provided to create multiple openings for the endplates **1312***a*, **1312***b* to reside. The support member **1356***a*, **1356***b* may also have at least one opening **1358***a*, **1358***b* extending therethrough to retain a corresponding protrusion **1314***a*, **1314***b* on the endplates **1312***a*, **1312***b*. The opening **1358***a*, **1358***b* in the support member **1356***a*, **1356***b* may be elongated with a curved or beveled perimeter designed to provide an interference fit when the endplate **1312***a*, **1312***b* is snapped into the openings of the frame **1350***a*, **1350***b*. Although a single opening **1358***a*, **1358***b* in the support member **1356***a*, **1356***b* is shown, additional openings may also be provided to secure the endplates **1312***a*, **1312***b*. In addition or alternatively, similar openings may be provided in the arms **1354***a*, **1354***b* of the frame **1350***a*, **1350***b* to secure the endplates **1312***a*, **1312***b*. The front portion **1365***a*, **1365***b* may have a height greater than the height of the arms **1354***a*, **1354***b* and/or the rear portion **1355***a*, **1355***b*. In addition, the support member **1356***a*, **1356***b* may have a height greater than the height of the arms **1354***a*, **1354***b*.

One or more endplates **1312***a*, **1312***b* are positioned on and affixed to the frame **1350***a*, **1350***b* such that at least a portion of the endplates **1312***a*, **1312***b* is received within the openings in the frame **1350***a*, **1350***b*. The endplates **1312***a*, **1312***b* may be inserted from the top or the bottom of the implant **1300***a*, **1330***b*. The endplates **1312***a*, **1312***b* may include upper and lower surfaces configured to contact and engage adjacent vertebrae (not shown). The upper and lower surfaces may be parallel, curved, or angled to help restore or recreate a lordosis angle (or other angle) of the human spine. In addition, the upper and/or lower surfaces may be contoured to conform more closely to the concave endplates of the adjacent vertebra.

The endplates **1312***a*, **1312***b* may be L-shaped with a stepped configuration, for example, or may include a raised portion sized and configured to fit within the central opening of the frame **1350***a*, **1350***b*. For example, the raised portion may form a portion of the upper and/or lower surfaces. This configuration may allow for the endplates **1312***a*, **1312***b* to bottom out on the frame **1350***a*, **1350***b* preventing excessive force from pushing the endplates **1312***a*, **1312***b* out the other end of the implant **1300***a*, **1300***b* upon insertion. The endplates **1312***a*, **1312***b* may include a plurality of protrusions **1313***a*, **1313***b* or teeth on the contact areas of the upper and/or lower surfaces to engage the adjacent vertebrae. The protrusions **1313***a*, **1313***b* may help to grip the endplates of the adjacent vertebrae, resist migration, and aid in expulsion resistance. The plurality of protrusions **1313***a*, **1313***b* may be pyramidal in shape and may form a series of ridges and grooves (as shown), but the protrusions **1313***a*, **1313***b* can be configured to be any size or shape to enhance anchoring the implant **1300***a*, **1300***b* to each of the adjacent vertebrae.

As shown in FIGS. **15**A and **15**B, two endplates **1312***a*, **1312***b* may be provided for each implant **1300***a*, **1300***b*. The endplates **1312***a*, **1312***b* for each respective implant **1300***a*, **1300***b* may be mirror images of one another. The endplates **1312***a*, **1312***b* may include a lateral surface having at least one protrusion **1314***a*, **1314***b* extending outwardly therefrom. The edges of the protrusion **1314***a*, **1314***b* may be chamfered or beveled such that the protrusion **1314***a*, **1314***b* provides an interference fit with the opening **1358***a*, **1358***b* in the support member **1356***a*, **1356***b*. Although depicted with the protrusions **1314***a*, **1314***b*, the endplates **1312***a*, **1312***b* may be secured to the frame **1350***a*, **1350***b* using any of the mechanisms or techniques described herein.

A sixteenth embodiment is shown in FIGS. **16**A and **16**B, which depict exploded views of implants **1400***a*, **1400***b*. This embodiment is substantially the same as the implants **1300***a*, **1300***b* discussed above, and the discussion for implants **1300***a*, **1300***b* applies equally here. In this particular embodiment, implants **1400***a*, **1400***b* include a frame **1450***a*, **1450***b* with one or more endplates **1412***a*, **1412***b*. Instead of forming a ring or loop, the frame **1450***a*, **1450***b* includes extensions or arms **1454***a*, **1454***b* and support member **1456***a*, **1456***b* to secure the endplates **1412***a*, **1412***b*. The endplates **1412***a*, **1412***b* may be in the form of PEEK or allograft spacers, for example, sized and configured to fit within the openings or channels defined between the arms **1454***a*, **1454***b* and support member **1456***a*, **1456***b*.

The front portion **1465***a*, **1465***b* of the frame **1450***a*, **1450***b* defines one or more fastener apertures **1434***a*, **1434***b* configured to secure fasteners, such as bone screws (not shown), in both the superior and inferior vertebrae. In this embodiment, the frame **1450***a*, **1450***b* provides three fastener apertures **1434***a*, **1434***b* extending through the front portion **1465***a*, **1465***b* of the frame **1450***a*, **1450***b* at an angle to secure fasteners, such as bone screws, in both the superior and inferior vertebrae. As described herein, once inserted through the fastener apertures **1434***a*, **1434***b*, the fasteners may be secured with an anti-back out prevention or locking mechanism **1420***a*, **1420***b*, such as by using one or more blocking screw to capture a portion of the fasteners to prevent back out.

The frame **1450***a*, **1450***b* may include a first arm **1454***a*, **1454***b* extending from a first end of the front portion **1465***a*, **1465***b* and a second arm **1454***a*, **1454***b* extending from a second end of the front portion **1465***a*, **1465***b*. A support member **1456***a*, **1456***b* may be positioned between the arms **1454***a*, **1454***b*. As shown, the support member **1456***a*, **1456***b* may be positioned at a medial portion of the implant **1400***a*, **1400***b*, and may be positioned centrally between the arms **1454***a*, **1454***b*. It is envisioned, however, that the support member **1456***a*, **1456***b* may be absent creating a single large opening, the support member **1456***a*, **1456***b* may be offset creating unequally sized openings, or more than one support member **1456***a*, **1456***b* may be provided to create multiple locations for the endplates **1412***a*, **1412***b* to reside.

The support member **1456***a*, **1456***b* may also have at least one opening **1458***a*, **1458***b* extending therethrough to retain a corresponding protrusion **1414***b* (protrusion not visible in FIG. **16**A) on the endplates **1412***a*, **1412***b*. The opening **1458***a*, **1458***b* in the support member **1456***a*, **1456***b* may be elongated with a curved or beveled perimeter designed to provide an interference fit when the endplate **1412***a*, **1412***b* is snapped into openings or channels between the arms **1454***a*, **1454***b* and support member **1456***a*, **1456***b*. Although a single opening **1458***a*, **1458***b* in the support member **1456***a*, **1456***b* is shown, additional openings may also be provided to secure the endplates **1412***a*, **1412***b*. In addition or alternatively, similar openings may be provided in the arms **1454***a*, **1454***b* of the frame **1450***a*, **1450***b* to secure the endplates **1412***a*, **1412***b*.

One or more endplates **1412***a*, **1412***b* are configured to be positioned on and/or affixed within openings or channels between the arms **1454***a*, **1454***b* and support member **1456***a*, **1456***b*. The endplates **1412***a*, **1412***b* may be inserted from the top, bottom, or back of the implant **1400***a*, **1400***b*. The endplates **1412***a*, **1412***b* may include upper and lower surfaces configured to contact and engage adjacent vertebrae (not shown). The upper and lower surfaces may be parallel, curved, or angled to help restore or recreate a lordosis angle (or other angle) of the human spine. In addition, the upper and/or lower surfaces may be contoured to conform more closely to the concave endplates of the adjacent vertebra.

The endplates **1412***a*, **1412***b* may be notched or provided with a stepped configuration or may include a raised portion sized and configured to fit between the arms **1454***a*, **1454***b* and support member **1456***a*, **1456***b*. This configuration may allow for the endplates **1412***a*, **1412***b* to bottom out on the frame **1450***a*, **1450***b* preventing excessive force from pushing the endplates **1412***a*, **1412***b* out the other end upon insertion. The endplates **1412***a*, **1412***b* may include protrusions **1413***a*, **1413***b* or teeth on the contact areas of the implant **1400***a*, **1400***b* as discussed herein.

As shown in FIGS. **16**A and **16**B, two endplates **1412***a*, **1412***b* may be provided for each implant **1400***a*, **1400***b*. The endplates **1412***a*, **1412***b* for each respective implant **1400***a*, **1400***b* may be mirror images of one another. The endplates **1412***b* may include a lateral surface having at least one protrusion **1414***b* extending outwardly therefrom. Similar protrusions are provided on endplates **1412***a* in FIG. **16**A, which are not visible in the view provided. The edges of the protrusion **1414***b* may be chamfered or beveled to provide an interference fit with the opening **1458***b* in the support member **1456***b*. Although shown to be secured with the protrusions **1414***b*, the endplates **1412***a*, **1412***b* may be additionally or alternatively secured to the frame **1450***a*, **1450***b* using any of the mechanisms or techniques described herein.

As shown in FIGS. **17**A and **17**B, a seventeenth embodiment includes exploded views of implants **1500***a*, **1500***b*. This embodiment is substantially the same as the implants **1400***a*, **1400***b* discussed above, and the discussion for implants **1400***a*, **1400***b* applies equally here. Implants **1500***a*, **1500***b* include a frame **1550***a*, **1550***b* with one or more endplates **1512***a*, **1512***b* configured to be positioned between the extensions or arms **1554***a*, **1554***b* and support member **1556***a*, **1556***b* to secure the endplates **1512***a*, **1512***b*. This embodiment includes protrusions **1514***a*, **1514***b* on the medial portion of the endplate **1512***a*, **1512***b* as well as indentations **1516***a*, **1516***b* on the lateral portion of the endplate **1512**, **1512***b* to provide an interference fit with the frame **1550***a*, **1550***b*. The endplates **1512***a*, **1512***b* may be in the form of PEEK or allograft spacers, for example, sized and configured to fit within the openings or channels between the arms **1554***a*, **1554***b* and support member **1556***a*, **1556***b*.

The frame **1550***a*, **1550***b* may include a first arm **1554***a*, **1554***b* extending from a first end of the front portion **1565***a*, **1565***b* and a second arm **1554***a*, **1554***b* extending from a second end of the front portion **1565***a*, **1565***b*. The support member **1556***a*, **1556***b* may be positioned between the arms **1554***a*, **1554***b*, for example, at a central location between the arms **1554***a*, **1554***b*. The support member **1556***a*, **1556***b* may have at least one opening **1558***a*, **1558***b* extending therethrough to retain a corresponding protrusion **1514***a*, **1514***b* on the medial portion of the endplates **1512***a*, **1512***b*. The opening **1558***a*, **1558***b* in the support member **1556***a*, **1556***b* may be elongated with a curved or beveled perimeter designed to provide an interference fit when the endplate **1512***a*, **1512***b* is snapped into openings or channels between the arms **1554***a*, **1554***b* and support member **1556***a*, **1556***b*. The lateral portion of the endplates **1512***a*, **1512***b* may include at least one indentation **1516***a*, **1516***b* therein to retain a corresponding protrusion **1518***a*, **1518***b* on an interior surface of the arms **1554***a*, **1554***b*. The indentation **1516***a*, **1516***b* in the endplates **1512***a*, **1512***b* may be substantially square with a curved or beveled perimeter designed to provide an interference fit when the endplate **1512***a*, **1512***b* is snapped into openings or channels between the arms **1554***a*, **1554***b* and support member **1556***a*, **1556***b*. The protrusions **1514***a*, **1514***b* on the endplates **1512***a*, **1512***b* may be larger in size and shape than the protrusions **1518***a* **1518***b* on the arms **1554***a*, **1554***b*, for example. Although it is envisioned that any size, shape, dimension, and position for the protrusions **1514***a*, **1514***b*, **1518***a*, **1518***b* may be selected by one of ordinary skill in the art.

The endplates **1512***a*, **1512***b* may be notched and contoured to fit between the arms **1554***a*, **1554***b* and support member **1556***a*, **1556***b*. As shown in FIGS. **17**A and **17**B, two endplates **1512***a*, **1512***b* may be provided for each implant **1500***a*, **1500***b*. The endplates **1512***a*, **1512***b* for each respective implant **1500***a*, **1500***b* may be mirror images of one another. The endplates **1512***a*, **1512***b* may be inserted from the top, bottom, or back of the implant **1500***a*, **1500***b*. The endplates **1512***a*, **1512***b* may include upper and lower surfaces configured to contact and engage adjacent vertebrae (not shown). The upper and lower surfaces may be parallel, curved, angled, contoured, or the like to conform more closely with the endplates of the adjacent vertebra.

FIGS. **18**A and **18**B illustrate stand-alone intervertebral implants **1600***a*, **1600***b*, which may be suitable for an anterior lumbar procedure. The implants **1600***a*, **1600***b* include a spacer or frame **1650***a*, **1650***b* and one or more endplates **1612***a*, **1612***b*. The endplates **1612***a*, **1612***b* may be in the form of PEEK or allograft spacers, for example, sized and configured to fit within the openings in the frame **1650***a*, **1650***b*.

The frame **1650***a*, **1650***b* includes upper and lower surfaces each having contact areas (e.g., a plurality of protrusions **1613***a*, **1613***b*) configured to contact and engage adjacent vertebrae (not shown). The frame **1650***a*, **1650***b* may contain one or more openings which extend from the upper surface to the lower surface. The openings may be in the form of oval holes, for example. As shown, three openings may be provided: two posterior openings and one anterior opening. The openings may be configured for receiving bone graft material, for example, to promote fusion of the adjacent vertebral bodies.

In one embodiment, the openings may be configured to receive corresponding endplates **1612***a*, **1612***b*. The endplates **1612***a*, **1612***b* may be inserted from the top or the bottom of the implant **1600***a*, **1600***b*. The endplates **1612***a*, **1612***b* may be retained in the openings by a ridge **1614***a*, **1614***b* and corresponding slot or groove **1616***a*, **1616***b* located on a mid-transverse plane on the implants **1600***a*, **1600***b*. The ridge **1614***a*, **1614***b* may project around a perimeter of each endplate **1612***a*, **1612***b*. The ridge **1614***a*, **1614***b* may be centrally located between the upper and lower surface of the implant **1600***a*, **1600***b*, but is also envisioned that additional ridges may be provided or the ridge may be offset from the center line.

The endplate **1612***a*, **1612***b* upon insertion has an interference fit and then snaps into the corresponding groove **1616***a*, **1616***b* on the frame **1650***a*, **1650***b*. The endplates **1612***a*, **1612** may be in the shape of ovals although any suitable shape is envisioned. The posterior ovals are substantially the same and are interchangeable. The anterior oval has a distinct feature on its bottom; namely, a slot for the fastener, to distinguish it from the posterior ovals. The endplates **1612***a*, **1612***b* may also include protrusions on the upper and/or lower surfaces which match and align with the protrusions **1613***a*, **1613***b* on the frame **1650***a*, **1650***b*.

The inserts, members, frames, spacers, and endplates described in this document may be comprised of any suitable materials. The spacers or endplates can be comprised of any material that is conducive to the enhancement of fusion between the two adjacent vertebrae. In one particular embodiment, the spacer or endplate is made of a biocompatible plastic, like polyether ether ketone (PEEK), polyetherketoneketone (PEKK), ultra-high molecular weight (UHMW) polyethylene, or other polymers and plastics known in the art which are physiologically compatible. Any other materials that are physiologically compatible may also be used such as bone or metal. The inserts, members, or frames can also be comprised of any physiologically compatible materials. In the preferred embodiment, the inserts, members, or frames are composed of a biocompatible metal, such as stainless steel, titanium, titanium alloys, surgical steel, and metal alloys, for example. Preferably, the inserts, members, or frames are formed from titanium or a titanium alloy. Any other materials that are physiologically compatible may also be used such as bone or plastic.

Although the invention has been described in detail and with reference to specific embodiments, it will be apparent to one skilled in the art that various changes and modifications can be made without departing from the spirit and scope of the invention. Thus, it is intended that the invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents. It is expressly intended, for example, that all ranges broadly recited in this document include within their scope all narrower ranges which fall within the broader ranges. It is also intended that the components of the various devices disclosed above may be combined or modified in any suitable configuration.

What is claimed is:

**1**. An intervertebral implant for implantation in an intervertebral space between adjacent vertebrae, the implant comprising:

a frame having a front portion, a first arm portion extending from a first end of the front portion, and a second arm portion extending from a second end of the front portion, the front portion at least partially defining at least one fastener aperture sized and dimensioned for receiving a fastener, wherein the front portion is divided into two separate portions with a passage positioned therebetween; and

an endplate including an outer surface having a contact area configured to engage adjacent vertebrae, the endplate being affixed to the frame such that the endplate contacts at least a portion of the first and second arm portion, wherein the endplate includes a central portion sized and configured to fit within the passage in the front portion, the central portion defining an opening sized and configured to receive an insert which accepts an anti-backout locking mechanism.

**2**. The implant of claim **1**, wherein the first and second arm portion join together at a rear portion of the frame to form a ring-like structure.

**3**. The implant of claim **1**, wherein the endplate defines an indentation on a lateral portion of the endplate to retain a corresponding protrusion on one of the first and second arm portion which is configured to provide an interference fit between the endplate and the frame.

**4**. The implant of claim **1**, wherein the endplate is configured to be inserted from a top, bottom, or back of the implant.

**5**. The implant of claim **1**, wherein the endplate includes a first lateral wing and a second lateral wing, the first lateral wing being configured to contact a portion of the first arm, and the second lateral wing being configured to contact a portion of the second arm.

**6**. The implant of claim **1**, wherein the front portion has a height greater than the first and second arm portion.

**7**. The implant of claim **1**, wherein the endplate includes an additional endplate having a substantially c-shaped configuration.

**8**. The implant of claim **1**, further comprising an additional endplate having a recess or channel configured to retain a portion of the first or second arms.

**9**. The implant of claim **1**, wherein the endplate is secured to the frame with two pins.

**10**. An intervertebral implant for implantation in an intervertebral space between adjacent vertebrae, the implant comprising:

a frame having a front portion, a first arm portion extending from a first end of the front portion, and a second arm portion extending from a second end of the front portion, wherein the first and second arms join together at a rear portion of the frame to form a ring-like structure, wherein the front portion is divided into two separate portions with a passage positioned therebetween; and

an endplate including an outer surface having a contact area configured to engage adjacent vertebrae, the endplate being affixed to the frame such that the endplate contacts a portion of the first or second arm portions, wherein the endplate includes a central portion sized and configured to fit within the passage in the front portion.

**11**. The implant of claim **10**, wherein the central portion defines an opening sized and configured to receive an insert.

**12**. The implant of claim **10**, wherein the endplate includes a lateral wing configured to contact a portion of the first arm or a portion of the second arm.

**13**. The implant of claim **12**, wherein the endplate is secured to the frame with two pins extending from the at least one lateral wing to the frame.

**14**. The implant of claim **10**, wherein the front portion has a height greater than the first and second arm portions.

**15**. The implant of claim **10**, wherein the front portion includes a torsional stabilizer.

**16**. An intervertebral implant for implantation in an intervertebral space between adjacent vertebrae, the implant comprising:

a frame having a front portion, a first arm portion extending from a first end of the front portion, and a second arm portion extending from a second end of the front portion, the front portion at least partially defining at least one fastener aperture sized and dimensioned for receiving a fastener, wherein the front portion is divided into two separate portions with a passage positioned therebetween; and

an endplate including an outer surface having a contact area configured to engage adjacent vertebrae, the endplate being affixed to the frame such that the endplate contacts a portion of the first or second arm portions, wherein the endplate includes a central portion sized and configured to fit within the passage in the front portion.

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